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MULTIPLEX TELEGRAPHY.

THE constant demand which is made from time to time for a decrease in the price of telegrams shows that any devices which may enable a large amount of telegraph work to be transmitted at a small cost would be likely to prove remunerative to an inventor. The latter, however, before proceeding to design such apparatus should first clearly understand the conditions under which economy would result from the adoption of the same. At the present time several forms of multiplex and also of fast speed instruments are in existence, and, under certain conditions, they do their work well. The Baudot, for example, is used on the Continent with success; but no one who has seen its construction can say that the latter is simple or that the very general adoption of the instrument would conduce to economy. The item of maintenance is one which most inventors who work simply as mechanicians, almost entirely, if not entirely, leave out of calculation; yet any complication in telegraphic mechanism which renders it unusually liable to derangement adds considerably to its annual expense, and this may more than counterbalance any advantages which may be inherent in the principle on which the apparatus is constructed. Simple as is the simplest form of multiplex apparatus — viz., the duplex — it, on its first introduction, proved a failure from the defective state in which the telegraph lines were at the period. At the present day, on account of the excellent condition into which experience has enabled the aërial lines in this country to be brought, the duplex system works without difficulty; and even the more recent development, the quadruplex, is largely employed. But the latter, in spite of the perfection to which it has been brought in Great Britain (having been entirely remodelled from the original American instruments), cannot be made to work satisfactorily over lines of an extreme length, owing to the variations which continually take place from the extreme humidity of this climate. Were the Baudot instrument tried, its failure here would be certain. A successful multiplex instrument, therefore, would have to be designed on principles somewhat different to those upon which the Baudot is constructed. Should the use of underground lines become general, the employment of multiplex instruments would probably come within the range of practicable telegraphy, as the element of variation would practically cease to exist, though the element of inductive retardation would have to be overcome. Although we believe that eventually this will be the case, yet at the present time not the slightest real progress has been made towards counteracting its effects by any method of transmitting signals.

ON A NEW FORM OF DIFFERENTIAL GALVANOMETER FOR THE DIRECT MEASUREMENT OF THE ELECTRICAL RESISTANCE OF INCANDESCENT CARBON FILAMENTS.

BY DR. AUGUST VOLLER.

FOR determining the resistance of a body which forms part of an electric circuit and in which no electromotive forces are manifested, there are now employed —disregarding older processes—principally two methods, that of Wheatstone's bridge in its various modifications, and that of the differential galvanometer, which has likewise been developed in different manners. The principle of the latter instrument, as is well known, is that a current passed through two parallel branches of equal resistance, appears in both branches with the same strength, and that equal lengths of both branches coiled upon a galvanometer needle at an equal distance in a similar, but opposite, manner, exert an equal, but opposite, magnetic momentum, so that the needle, when placed in its meridian, is not deflected by the action of the current. From the non-deviation of the quiescent needle, the equality of two resistances introduced into two parallel circuits can be inversely inferred. Thus the principle employed in the ordinary differential galvanometer is that of an equibrachial balance applied to electric forces. It is generally admitted that this instrument possesses great advantages, as the results are independent of any fluctuations in the strength of the current which happen during the course of the experiment, on account of the greater sensitiveness of the needle when near its position of rest, and also on account of the convenience and dispatch in working. The method with Wheatstone's bridge shares essentially the same advantages, but is only adapted for measuring resistances with the application of feeble currents. This limitation applies, generally speaking, also to the differential galvanometers generally in use, since here also the heating effect of strong currents modifies the resistances in question and affects the result in a manner which cannot be determined with certainty.

On this account the direct determination of conductor resistances has been hitherto unusual in those cases in which the application of strong currents was necessary. Such cases, until recently, did not often occur. The recent development of electrotechnics has occasioned a corresponding demand, in the first place practically, and then from a purely scientific point of view. In electric glow-lamps the production of light occurs in carbon filaments of great resistance, since they are traversed by currents whose intensity may reach one ampère and upwards; the potential difference as measured at the terminals of these lamps amounts generally to 100—110 volts. The resistance of these filaments, which, when cold, amounts to some hundred ohms, unlike that of metals, decreases with an increasing temperature. The strength of the current, and consequently the quantity of energy transformed into heat and light, is consequently a function of the resistance thus changing with the temperature.

From a purely practical point of view, *e.g.*, in the working of a glow-light installation, the direct determination of this resistance may appear unnecessary, since in virtue of Ohm's law

$$J = \frac{V - V_1}{W} \text{ or } W = \frac{V - V_1}{J}$$

the strength of the current in a portion of the conductor of the resistance, W, and the potential difference, $V - V_1$, referred to the extremities of the portion of conductor being mutually dependent, the measurement of J and of $V - V_1$ is sufficient to find W. In fact, in all cases where the determination of the electric dimensions of a glow-light were concerned the resistance has hitherto been measured in a cold state, *i.e.*, with the use of feeble currents. The

direct measurement of the resistance at higher temperatures, *i.e.*, during the burning of the lamp, was evaded by the application of Ohm's formula, since the ordinary differential galvanometers do not admit of the use of strong currents.

This indirect method of determining the resistance evidently fails to meet the scientific demand for measuring in a direct manner the resistance of a conductor heated even to whiteness by a strong current. And even in a purely practical respect the development of a direct method is of importance, *e.g.*, for testing glow lamps before use. It has been found by experience of great importance to introduce into one and the same circuit only lamps which, whilst their filaments are similar in other respects, possess, when hot, an equal resistance, which by no means follows from their equality of resistance as measured when cold. This is the most important condition, both for the lasting of the lamps and for their equal luminosity. The preliminary determination of this resistance in a hot condition should therefore be made an invariable rule. That it is so often neglected is due, doubtless, to the tediousness of the indirect method, according to which each lamp to be tested requires, for a given intensity of light, a double measurement—that of the intensity of the current and that of the potential difference. A trustworthy instrument which gives directly and conveniently the resistance for any strength of current in question, at any temperature, and especially at a white heat, will therefore be welcome to practical men.

The construction of a differential galvanometer for strong currents of the ordinary form, *i.e.*, with an equal resistance of both coils of wire, set at an equal distance from the magnetic needle, is, from practical reasons, not possible. In such an instrument the resistance to be measured requires an equal standard resistance, and the circuit is so arranged that the standard resistance is traversed by a current of the same strength as the resistance to be measured. If the standard resistances of metal wires were to be so arranged that they might be traversed by powerful currents without being sensibly heated, or undergoing a change of resistance, they would require to be of perfectly inadmissible dimensions. The suggestion was very natural to arrange the instrument so that the unknown resistance might be measured by a greater resistance, suitably selected, as in this case the latter is traversed by a part of the current, smaller in the inverse proportions of both resistances. The dimensions of the standard resistance may then be as usual without any fear of injurious heating, whilst, on the other hand, very great resistances may be measured by small standard resistances, not over-stepping practicable limits.

Instruments of this kind exist which exhibit a two-fold divergent application of the fundamental idea. In the meeting of the British Association, September, 1867, William Siemens and Fleeming Jenkin each proposed a new resistance gauge, the former a complete instrument, the latter merely the plan. Both instruments agreed in the point that the constant resistances of both branches of the current are equal, whilst the standard resistance may be equal to, or greater or smaller than, the resistance to be measured. The differential galvanometer of Siemens, especially adapted for the testing of telegraph cables, has a movable galvanometer needle, perpendicular to the mutually parallel planes of the wire coils; the equality of the magnetic momenta of both coils upon the needle can thus be effected by changing its distance in the same manner as the equality of the static momenta in a steelyard. The magnitude of the resistance to be measured, which, if a constant standard resistance is applied, necessitates the observed displacement of the needle, is read off on a scale determined empirically. The instrument, however, is not intended and not suited for strong currents. If there is a considerable difference in the two resistances introduced the sensitiveness rapidly diminishes; moreover, if the position of equilibrium of the needle is very excentric a peculiar inertia of the needle appears, as will be explained below. As this excentric position of the needle in the Siemens differential galvanometer is involved in the theory of the instrument, the resulting lack of sensitiveness is not to be avoided.

According to Fleeming Jenkin's proposal the magnetic momenta exerted upon the needle, when unequal resistances are introduced, are equalised by turning the planes, which are perpendicular to each other and inclined at an angle of 45° to the meridian position of the needle on a vertical axle, until the position of equilibrium of the needle is again obtained in the magnetic meridian. If in this case ϕ is the angle of deviation, and if r, R and x denote the resistance of each ring, the standard resistance and the resistance sought, the latter is found by the formula:—

$$\frac{r + x}{r + \mathrm{R}} = \text{tang. } \phi.$$

In consequence of a known property of trigonometric tangents the sensitiveness of the instrument is greatest when x and R are not very different, and when, therefore, tang. ϕ differ little from 1. In cases where the existence of strong currents necessitates a standard resistance, R, very large in comparison with x, and where ϕ is consequently small, the accuracy of the observations decreases rapidly. Jenkin's instrument is therefore not adapted for powerful currents.

Carpentier has recently proposed a similar instrument which agrees essentially with that of Jenkin, and to which the same remarks apply.

The convenient method of determining resistances by the differential galvanometer can, however, be made available for strong currents by the application of a principle resembling that on which the decimal balance is based.

If the two coils of the instrument (both introduced in a parallel position and at a mean distance from the needle) traversed by the current have different resistances, w and w_1, then, if no further resistances are introduced the current will distribute itself in both branches according to the equation $w\,\mathrm{J} = w_1\,\mathrm{J}_1$. The magnetic momenta of each unit of length of the coils upon the needle at rest will, if the circumstances are otherwise equal, be proportionate to the strengths of the current, J and J_1, the magnetic momenta of both entire systems of coils—differently from what takes place in the instrument of Siemens when resistances of different magnitude are introduced—can be equalised as follows:—We may, in the first place, make the length of the coiled wires proportional to their resistance, so that

$$\frac{w_1}{w} = \frac{l_1}{l} = n,$$

the more feeble momentum of one turn of the coil of the greater resistance is approximately compensated by the nearly n times greater number of the coils. This leads evidently to the condition that on both coils must be used wire of equal resistance per unit of length. If such wires are used on both coils, then as long as no other resistances are introduced the equality of their magnetic momenta upon the needle is approximately reached when it is equidistant from the parallel middle planes. By displacing the needle or one of the two coils in a direction perpendicular to the plane of the coils a point will be found almost in the middle between both, in which the needle remains at rest when the circuit is closed. As, moreover, if the section of that wire which is to possess the greater total resistance, becomes greater, the length must undergo a corresponding increase; by a suitable selection of the wires the position of equilibrium of the needle, with reference to the magnetic momenta of the two coils, may be made to fall at the point of the greatest sensitiveness, *i.e.*, in the middle between both bobbins, if the instrument contains no further resistances. If the momenta of the two coils upon the needle are denoted in this case by M and N we have

$$\frac{\mathrm{J}}{\mathrm{J}_1} = \frac{w_1}{w} = n \text{ and } \frac{\mathrm{J}\,c}{\mathrm{J}_1\,c_1} = \frac{\mathrm{M}}{\mathrm{M}_1} = 1.$$

where c and c_1 are constants, depending on the form

and general structure of the wire coils, their distance from the poles of the needle and the magnetism of the latter, in other words from those values which must remain unchanged during the experiments. It is plain that if into both branches of the current there are introduced new resistances, W and W_1, whose proportion is also $= n$, the magnetic momenta of the coils likewise decrease in consequence of the decrease of the strengths of the currents, but if the distance of the needle is unchanged they always remain equal to each other. For in this case if i and i_1 denote the new strengths of the currents, and $m = i\,c$ and $m_1 = i_1\,c_1$, denote the new magnetic momenta, then

$$\frac{i}{i_1} = \frac{w_1 + W_1}{w + W}$$

$$\frac{w_1}{w} = \frac{W_1}{W} = \frac{w_1 + W_1}{w + W} = n$$

consequently

$$\frac{i}{i_1} = n = \frac{J}{J_1}$$

and further, as c and c_1 remain unaltered

$$\frac{i\ c}{i_1\ c_1} = \frac{J\ c}{J_1\ c_1}$$

whence

$$\frac{m}{m_1} = \frac{M}{M_1} = 1.$$

The needle will, therefore remain at rest in the former position of equilibrium if the proportion of the introduced resistances, W and W_1, is equal to the proportion of the resistances of the coils, w and w_1.

As the proportion $\frac{w_1}{w} = n$ can be selected at pleasure it follows that an unknown resistance, W, introduced into the galvanometer branch having the resistance, w, can be measured by a standard resistance

$$W_1 = n\,.\,W$$

of such a magnitude as to receive in proportion to the current, i, traversing W, so small a portion of the current, $i_1 = \frac{i}{n}$ that every injurious heating of this standard resistance is excluded, whilst the galvanometer needle always remains at the point of the greatest sensitiveness.

If $V - V_1$ denotes the potential difference at the points of the ramification, and the reunion of both branches of the current, the quantities of heat, A and A_1, evolved in lengths of equal resistance in both branches are as the products of the potential differences at the terminal points of these lengths with the accessory strengths of current ; therefore

$$A : A_1 = (V - V_1)\,.\,i : \frac{V - V_1}{n}\,.\,\frac{i}{n}$$

whence

$$A_1 = \frac{A}{n^2}.$$

The evolution of heat in the unit of the standard resistance is, therefore, n^2 times as small as in the unit of the resistance to be measured ; consequently n^2 times as small as it would be on using a differential galvanometer of the ordinary form with equal resistances in the coils. If, *e.g.*, $n = 20$ it will be only $\frac{1}{400}$.

The observation of the deviation of the needle, and of the return of the needle to rest can, of course, be effected by well-known methods, such as with a mirror and a telescope, or by directly reading off on a graduated circle over which a light vernier plays. The quiescent position of the needle can be determined by the terrestrial magnetic meridian, or, as is more to be recommended for practical use, by a sufficiently powerful magnet.

For the sake of examining the dependence of the resistance of organic carbon on its temperature, I have,

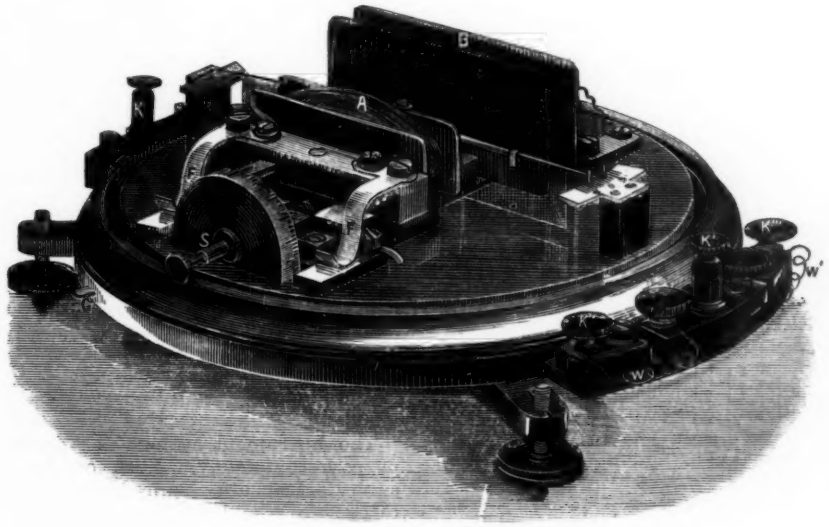


FIG. 1.

with reference to the principles above laid down, had a differential galvanometer with a direct scale constructed in the establishment of H. Schwenke. Its arrangement is shown in figs. 1 and 2. It effects in a very convenient manner the direct measurement of the resistance of the lamps of Swan, Edison, Müller, &c., both in a cold state and at a white heat. As these lamps require a current of 0·6 — 1 ampère, which consequently heats free filaments of carbon of the same kind as those in the lamps to the most intense whiteness, the size of the wires of the instrument were adapted to this intensity. Of the two coils that, into whose branch-current the carbon, or lamp, under examination is introduced, is traversed by a current of equal strength. It must, therefore, be constructed so that a current of 1 ampère produces no perceptible heating.

The second coil, into whose branch-current the standard resistance is introduced, is then naturally secure against heating. Accordingly the first bobbin, A, was wound with a well insulated nickel silver wire of 1·4 millimetre in diameter, and 3·6 metre in length = a resistance of 0·5 ohm. The absolute value of this resistance is unimportant, but the proportion, n, of the two resistances must be carefully retained. In my instrument $n = 20$. The second bobbin, B, was wrapped with a copper wire of 0·4 millimetre in

diameter, and 77·5 metres in length, equal to a resistance of about 10 ohms. As $0{\cdot}4^2 : 1{\cdot}4^2 = 1 : 12{\cdot}25$, whilst the specific resistance of copper is, to that of nickel silver, about as 1 : 13·25, the resistance of a unit (in length) of the copper wire is approximately equal to a unit of the nickel silver wire, whilst the total length of the copper is about twenty times that of the nickel silver wire. The exact determination of the proportion, $n = 20$, of the two bobbin resistances, measured between the clamps at the ordinary temperature of a dwelling room, was effected by carefully shortening the copper wire with a Wiedemann's measuring bridge. After this adjustment the equilibrium point of the electro-magnetic momenta of both bobbins upon the needle was almost at an equal distance from them. The necessity of selecting this position for the equilibrium of the electro-magnetic momenta appeared from the experiments made with the instrument. It was, at first, so constructed that the bobbin, B, containing the resistance, $W_1 = 20$ W, was wound with thinner wire, so that the number of coils was much less than twenty times those of the bobbin, A. Consequently the point of equilibrium lay near B. Then there appeared the peculiar defect that the needle was in a kind of unstable equilibrium. If the needle, in consequence of its vibrations, passed beyond the position of equilibrium it tended to remain on that side towards which it had moved. This peculiar sluggishness of the needle interferes, of course, with the sensitiveness of the instrument. It is probably due to the circumstance that its dimensions are not infinitely small in comparison with those of the bobbins, and hence the changes of the momenta of the bobbins upon the needle in its rotation does not ensue in equal proportions in consequence of the inequality of the differences. Hence this inertness disappears the more the smaller the mutual differences of the distances, so that the point of the maximum sensitiveness of the needle lies in the middle of the distance of the two bobbins.

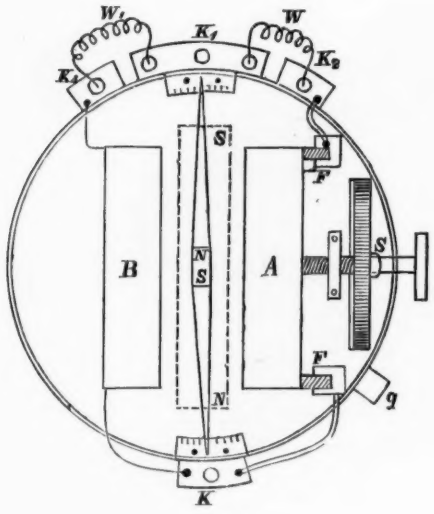


FIG. 2.

In order, after adjustment, to place the needle with absolute accuracy in the point of equality of the magnetic momenta, the bobbin, A, can be displaced by means of a sliding movement. This displacement is effected by the screw, S, the pitch of which is 1 millimetre, and has a drum graduated in hundreth parts, so that on turning the latter 1 degree the bobbin, A, is displaced by $\frac{1}{100}$ millimetre. A displacement of even $\frac{1}{500}$ millimetre may be easily estimated. The current is brought up to this bobbin by means of two powerful copper springs, F F, which play against brass pieces in connection with the terminals.

The needle, *n s*, is placed at the point of equilibrium by means of a point and an agate cap; it has the length of 25 millimetres, and carries an aluminium pointer of 160 millimetres in length, which plays over a small graduated arc. As only the zero point has to be observed the arc is provided with check-rods which only permit deviations within $\pm$ 2°. The needle is in the magnetic field of a bar magnet, N S, capable of rotation, and placed below the base-plate of the instrument. Its action is to place the needle in any azimuth of the terrestrial magnetic meridian, and to prevent its sensitiveness from sinking below the limit necessary for accurate observation. In placing the instrument the direction of the magnetic meridian is therefore a matter of indifference.

The rapid placing of the needle in its position of equilibrium is effected by means of two leaflets of mica, fixed to the aluminium index and hanging perpendicularly downwards. These effect a perfectly adequate checking of the movements of the needle in the space between A and B, which is closed in by a glass bell, covering the instrument. The spindle of the screw, S, projects outwards through a perforation of the bell. Further, all the terminals, the magnet, N S, and the handle, G, of a catch for the needle are outside of the bell, and are thus readily accessible. The two terminals are shown in the figure at K and K_1; K is in connection with A by means of the spring F, and also with B. The introduction of the standard resistance, and of the resistance to be measured between A (or B) and K_1 is effected by the terminals K_2 K_3.

Observation with this instrument is convenient and simple and requires but little time. After the needle has been placed in any azimuth of the magnetic meridian and brought to the zero of the graduation by turning the magnet, N S, K and K_1 are connected with the wires of the battery or of the dynamo machine, but with the introduction of an ordinary key so that the current may be kept closed for a short time only at pleasure. The resistance, W, to be measured is then introduced between K_1 and K_2 and the standard resistance, *i.e.*, a plug-rheostat consisting of fine nickel silver wire, between K_1 and K_3. So much of the latter is introduced that the needle remains at rest without pressing down the key. If W_1 ohms are required for this purpose, then

$$W = \frac{W_1}{20} \text{ ohm.}$$

The instrument arranged as described answers its purpose completely. Even on applying far weaker currents than are required for raising a carbon filament or a glow lamp to a white heat, an increase or decrease of the resistance, W_1 (which determines the zero position of the needle), of one ohm gives a distinct deviation of the needle to one side or the other, so that W can be read off with ease to $\frac{1}{20}$ ohm. With stronger currents this accuracy is considerably increased without any perceptible increase of heat in the wires. The instrument therefore enables the resistance of the ordinary forms of glow lamps to be measured either in the cold state or at a white heat. It scarcely need be added that the sensitiveness of the instrument for weak currents can be increased at pleasure by increasing the length of the wire on the bobbins. The instrument can also be arranged for any more powerful current by a suitable selection of the thickness of the wire or by increasing the proportion, *n*.

In order to exemplify the results of the instrument and at the same time to give a sketch of the changes of resistance in a glow lamp on increasing the strength of the current, a series of experiments are here quoted which were made with a Müller lamp of the older type (with a single twist of the carbon filament). The current was generated by a freshly-charged chromic acid battery, beginning with one element and gradually increasing up to 46 elements. The resistance of the lamp decreased from 78·85 to 38·15 ohm. The strength of the current could not be raised further as the light of the lamp became dazzling and strongly blueish, so that any further increase would have involved its destruction. The electromotive force of each chromic acid element amounted, according to

previous measurements, to a mean of 1·6 volt, the internal resistance was 0·1 ohm, from which were calculated the potential differences given in the second column of the subjoined table. The figures in this column give merely an approximate representation of the change. On account of the polarisation always occurring in chromic acid elements these figures naturally can lay no claim to absolute accuracy. The intensity of light to be obtained with the lamp in ordinary practice was obtained with 33 elements and a resistance in the lamp of 49·15 ohm., the E.M.F. at the terminals is calculated at 49·4 volts, and the strength of the current at $\frac{49{\cdot}4}{49{\cdot}15} = 1$ ampère. The resistances in the third and fourth columns were measured in Siemens' units and re-calculated in ohms.

Number of Elements.	$v - v_1$ in volts (electromotive force at the terminals).	W_1 in ohms.	W in ohms.	Condition of the Carbon Filament.
1	1·6	1577	78·85	Cold.
3	4·8	1509	75·45	
6	9·5	1406	70·30	
9	14·2	1322	66·10	Distinct red heat.
12	18·9	1257	62·85	
15	23·4	1202	60·10	Bright redness.
18	27·9	1151	57·55	
21	32·4	1109	55·45	Very bright red.
24	36·8	1072	53·60	White heat.
27	41·2	1037	51·85	
30	45·2	1009	50·45	Bright white.
33	49·4	983	49·15	Very bright white.
36	53·4	950	47·50	Dazzling.
39	57·2	909	45·45	
42	61·1	840	42	Blueish.
44	63·4	797	39·85	
46	65·6	963	38·15	Strongly blueish.

The convenient and accurate work of the new instrument above described led to the construction of a second, specially adapted for testing glow lamps, and shown in fig. 3.

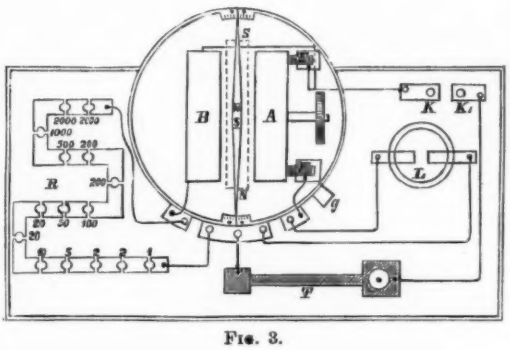


FIG. 3.

This differs from the first model merely by the addition of the rheostat, R, and a key, T, which, when pressed down, closes the circuit. There is also a lamp-holder, L, between A and K_1. It contains two elastic metal tongues, which are pressed down when the lamp is put in, and introduce it into the circuit. The course of the current is seen in the figure.—*Central-Blatt für Elektrotechnik.*

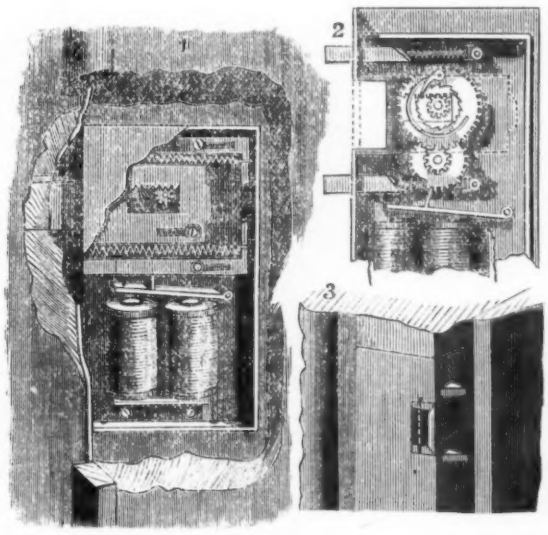
The Longitude of the Canary Islands.—We learn that the Astronomical Commission sent to Teneriffe by the Spanish Government, and to which we referred in our number of the 21st ult., have concluded their first series of observations, and that the observers in San Fernando are now going to change places with their colleagues in Teneriffe, for the purpose of checking the personal error.

ELECTRIC DOOR KEEPERS.

THIS electric liberating door holder which we notice in the *Scientific American*, is designed for the outside doors of buildings generally known as French flats. It has been patented by Mr. A. C. Woehrle, of 2187, Third Avenue, New York city.

The enclosing shell is secured to the door post by screws in the ordinary manner. A sliding keeper, having right angled portions, is held in the shell by a screw passing through a slot. In closing the door the lock bolt rubs against the outer part of the keeper and drops behind the edge, thus keeping the door closed. The inner part of the keeper is furnished with a slot which is formed with a rack which, in connection with the jaws, pinions, cog wheels, and ratchet (shown plainly in fig. 2), serves to lock the keeper forward, in the position shown in fig. 3, except when the lower pawl is drawn downward against the tension of the spring by passing a current of electricity through the electro-magnets.

Sliding bolts formed with bevelled ends are placed in slots in the case, and their inner ends are held by screws passing through slots, fig. 1. The bolts are held pressed forward by coiled springs, and are connected with the sliding keeper by coiled springs, as clearly indicated in fig. 1. When the door is open the bolts stand in the position shown in figs. 2 and 3, with the



bevelled ends protruding from the slots in the shell; but when the door is closed the bolts will be forced inward, thereby compressing the springs shown in fig. 2, and distending those in fig. 1, and the latter, when the lower pawl is drawn down by the magnets to free the cog wheel, serve to draw the keeper within the shell and away from the front of the bolt, thus liberating the door so that it may be forced open by the action of the spring attached to it in the ordinary way. The parts then assume their original position. When closed, the door cannot be opened except by operating the bolt directly, by door knob or key, or by passing a current of electricity to the magnets. Circuit wires connect the magnets with the poles of a battery and with buttons situated in the different stories of the building.

Technical Education.—Her Majesty has been pleased to confer the honour of a baronetcy upon Mr. Bernhard Samuelson, M.P., and the honour of knighthood upon Prof. Roscoe, F.R.S., in consideration of the services rendered by them in connection with the Technical Education Commission.

WORK-MEASURING MACHINES.

UNDER this title a little *brochure* has recently appeared from the pen of the Rev. F. J. Smith, B.A., of Taunton, in which work-measuring dynamometers, or *ergometers*, as the author terms them, of various forms are described. Amongst these machines, says *Nature*, there are many devised by the author himself, and some of these are of considerable interest and much originality. These transmission ergometers of the type originally invented by General Morin deserve notice in particular. The following is the principle involved in transmission ergometers :—

Let it be supposed that a belt passes over from the driving wheel of a prime-mover, such as a steam engine, to the pulley of a dynamo which is being driven. One half of the belt is subjected to a strong pull, the other is relatively slack. Then if we could introduce spring balances into the two parts of the belt, and if we could read the difference of the tensions T and T′, and if we multiplied this T − T′, expressed in pounds, by the velocity of the belt in feet per second, we should then have the "foot-pounds per second" spent in driving the dynamo. From this we can calculate the horse-power by dividing it by 550, since 550 foot-pounds per second is one horse-power. This we may write algebraically :—

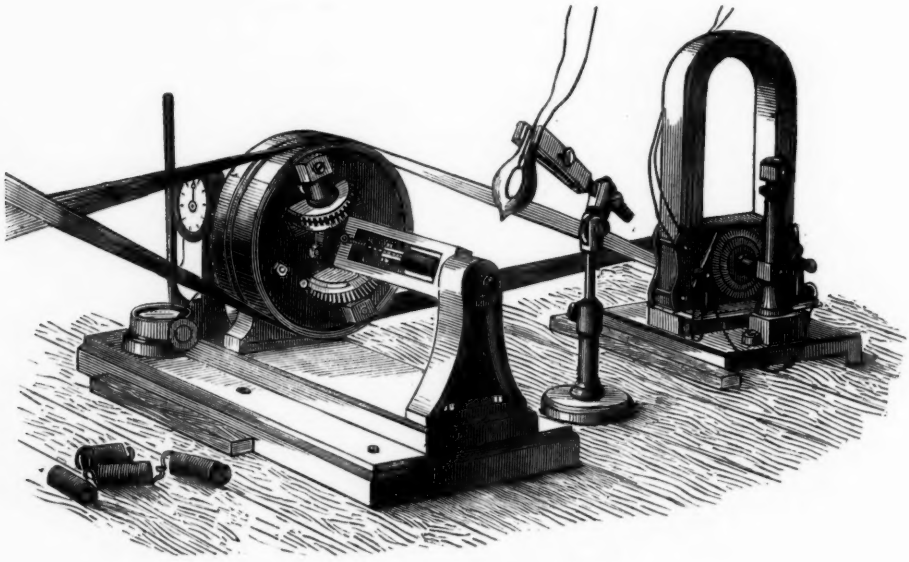
$$\text{H.P.} = \frac{(T - T')}{550} v :$$

where v denotes the velocity of the belt in feet per second.

Now, since such an arrangement as this cannot be easily carried out, the usual method is to place between the engine and the dynamo some instrument capable of showing the tension of the belt in pounds, and the velocity of the belt, and in certain cases these instruments can even give a continuous record of the work done. The ergometer devised by Mr. Smith is an admirable instance of such a combination, and it undoubtedly possesses points of superiority over all transmission dynamometers hitherto invented. A view of the machine (see figure) shows how the ergometer is arranged. The central shaft, of Whitworth steel, which is tubular at each end and link-shaped between, carries two pulleys. One is keyed to the shaft and carries two bevel-wheels, these engage with another bevel-wheel which forms part of the second pulley, which is loose on the shaft.

To each of the two bevel-wheels, as shown in the diagram, there is fitted a cylindrical drum, on these either gut or steel tape is coiled over three-fourths of their faces, and the gut or tape is attached to a cross-head. The latter is in turn attached to a cylindrical steel spring placed within the link, and from the cross-head a rod of steel, passing through one end of the link, actuates the pointer of a dial, whereby the pull on the spring attached to the end of the link is shown. This instrument resembles, therefore, the earlier dynamometer of Morin in having two pulleys ; the angular advance of one of them being regulated by a spring. But in Morin's form the spring was simply an extended piece of steel. In the more recent modification by Profs. Ayrton and Perry, coiled steel springs are also used ; but in that instrument the springs are liable to fly out by centrifugal force, and the arrangement for observing the angular advance is an optical one, requiring an observation of a silvered bead by a reading-telescope. In Mr. Smith's ergometer there is no such tendency of the spring to fly, and the tension is read direct on a dial. The speed indicator is shown just below. If a continuous record of work is required, the steel rod is either attached to a recording drum or to an integrating apparatus.

The instrument having been placed between a prime-mover and a machine to be tested, the belt from the prime-mover drives the loose pulley, and another belt



from the fixed pulley drives the machine to be tested. The tension on the driving side of the belt causes the spring to be extended by means of the bevel-wheels, and the difference of the tensions is indicated by the pointer of the dial. The instrument is calibrated by hanging known weights from strong thin cords or catgut strings passing round the pulleys, and marking the dial in accordance with the weights.

The springs used by Mr. Smith are made by Messrs. Salter & Co., they are of four sizes, capable of being extended 2 inches by 50, 100, 150, and 200 lbs. respectively. They have been put to severe tests, but have come out of them quite unaltered. However, so as to leave no doubt as to the accuracy of the readings of the ergometer, the instrument is finally calibrated by another method, which is new ; it is as follows :—

Let a prime-mover (a water-wheel appears to be the most steady) drive the transmission ergometer, and let the ergometer drive a pulley on a shaft embraced by a suitable friction ergometer, such as a Prony brake or an Appold's brake, and let the work done against friction be calculated. This should agree with the results of the transmission machine. If it does, we may conclude that it has been correctly calibrated. The advantage of this method is that the transmission machine is tested while running in its usual condition. When

testing a dynamo care should be taken that the speed indicator be well attached to the shaft the velocity of which it is measuring. A piece of coiled spring, such as is used in a dentist's lathe, answers well to connect it to the machine.

The leading feature of this instrument is the position of the spring in it. The axis of the spring and of the shaft coincide; the result of this is that it is hardly at all affected by centrifugal force. When springs of slight pull are used and the ergometer is driven at a great velocity, the deformation is considerable, and would introduce considerable error into the result.

The deformation of the spring has been fully appreciated by Schuckert, and therefore he has placed the spiral springs of his ergometer in cylindrical cases.

When the spring is placed with its axis coincidental with that of the machine, no such error can be introduced, and the friction of a spring against a case is avoided.

When a continuous record of work is required, a cylinder, not shown in the figure, is placed at the dial end of the instrument, and is driven at a speed proportional to the speed of driving. It carries a band of paper which receives a continuous trace from three self-feeding ink-pens: one pen is attached to the lever which is moved by the extension of the spring, and it writes ordinates directly proportional to the amount of extension of the spring at any instant; the second pen, attached to the lever of an electro-magnet magnetised by a current controlled by a seconds pendulum, describes a V-shaped mark at each second; the third pen traces a datum line to which the ordinates are perpendicular. The area traced out is of course the product of the two variables, and is proportional to the total work transmitted. The recording drum may be made to revolve at any convenient ratio to the revolutions of the belt wheels.

THE TOEPLER-HOLTZ MACHINE.

THE Toepler-Holtz induction electric machine is too well known to need description; but, as no explanation of its action is to be found in any book which has come under my observation, says Mr. H. W. Eaton, in *Science*, the following explanation may be of interest to teachers:—

Consider the machine before you, the revolving-plate in front.

Designate the right-hand paper sector by a, the brush connected with it by b, the comb connected with the discharging-rod by c, the comb in metallic connection with a similar comb diagonally opposite by d, and the corresponding parts on the left-hand side by a', b', c', and d'.

If the left-hand sector, a', be charged with negative electricity, it draws positive electricity from the comb, d' upon the revolving-plate, which is supposed to move in the direction of the hands of a watch. When the positive electricity on the plate reaches the brush, b, it draws negative electricity from the brush, and leaves the sector, a, charged with positive.

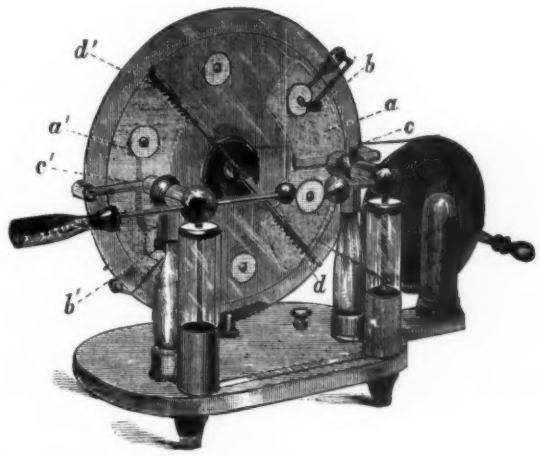
This positive electricity on the sector, and the positive that is left on the plate, both draw negative from the comb, c, and leave the discharging-rod connected with it charged with positive electricity.

The plate, now nearly neutral, passes under the diagonal comb, d, and from it receives a charge of negative electricity, drawn out by the positive on the sector, a, which at the same time repels positive electricity along the diagonal, and out of d' upon the revolving-plate.

The plate, now charged with negative electricity, passes under the brush, b', draws positive electricity from it, and thus increases the negative charge on the sector, a'. The residue of negative electricity on the plate, and the negative on the sector, both draw positive from the comb, c', and leave the discharging-rod connected with it charged with negative electricity. The plate, now nearly neutral, passes to our starting-point, d', and the process is repeated.

If the machine is operated in the dark, the brush, b', and the points on c' and d', will be tipped with the well-known positive brushes, while b, c, and d will show only the negative glowing points. The relative lengths of the brushes on c' and d' will depend on the position of the discharging-rods. If a is negative in the place of a', the position of the brushes will, of course, be reversed. The nature of the electricity on any part of the machine may be tested by bringing the point of a lead pencil near it, and noticing the form of the discharge from the point.

The great use of the knobs on the revolving-plate is to keep the paper sectors charged. Two knobs give better results than the usual six or eight; the reason apparently being, that the larger number of knobs keeps the sectors overcharged, and there is a continual loss (by brushes from the sectors) of electricity that would otherwise remain on the revolving-plate, and help to increase the charge on the discharging-rods.



Somewhat longer sparks are also obtained by connecting the sectors and discharging-rods on the same side by conductors; but the machine, thus arranged, reverses more readily, does not give sparks so rapidly when the discharging-knobs are near together, and is started by separating the knobs.

In some forms of the machine used in Germany the fixed plate is in two parts, separated by a vertical air-space. This is an improvement, because it prevents the electricities of the two sectors from uniting across the surface of the plate. Machines of this sort sometimes have as many as sixty revolving-plates, all on one axis. Such machines give large quantities of electricity, but not very long sparks.

The following experiments, not generally known, illustrate the power of the single plate machine. If a strip of vulcanite about two inches wide is moved to and fro in front of the positive pole, the length of the spark will be greatly increased, sometimes reaching five inches and a half on a machine whose revolving-plate is only ten inches and a half in diameter. If a drop of stearine is placed on a thin sheet of glass, which is too large for the spark to pass around the edges, and the glass is held between the discharging-knobs of a good ten-and-a-half-inch machine, with the drop toward the positive knob, the spark will pierce the glass when the knobs are about one inch apart.

Uses of Telegraphy.—A notable fact in connection with the increased advantage taken of the telegraph is that recently thousands of handbills containing extracts from an article upon the policy of the candidate for the Presidency of the United States, Mr. James G. Blaine, which appeared in the previous issue of the *Pall Mall Gazette*, were widely circulated in Cincinnati.

THE ORGANISATION OF THE POST AND TELEGRAPH SERVICE IN FRANCE.

(*Continued from page* 11.)

THERE was only one single cable belonging to the Government which connected France with Algiers, and this cable was laid in 1871. As this communication, however, was insufficient for the regular transmission of our messages, we were obliged to forward every day some 90 messages by one of the Marseilles-Bona cables, belonging to the Eastern Telegraph Company, and in consequence of this France had to pay an annual sum of about 80,000 francs.

Now, taking in account the fact, as proved by experience, that submarine cables last only a limited time, and that this cable laid in 1871 had already been in existence over seven years, we came to the conclusion that within a few years this communication might fail us altogether.

It became therefore urgent to proceed to the laying of a second cable, under penalty, in case of interruption of the only communication, to have to forward, over the cables of the Eastern Telegraph Company, the whole of the correspondence with our African territory; this, of course, would have been very onerous, and insufficient for the service.

The law of the 12th April, 1879, gave us the necessary means for the laying of a second cable between Marseilles and Algiers.

The laying of this cable was completed on the 11th October, 1879, its length being 917,666 metres. The immediate consequence of the establishment of this second cable was a considerable improvement in the service, as it enabled us to submit for your signature the decree reducing, from the 20th October, 1879, the price of telegrams between France and Algiers or Tunis, from 20 centimes to 10 centimes per word, with a minimum charge of one franc.

The number of Franco-Algerian telegrams for the term of the year, previous to the reduction of rates, was 202,394, producing a sum of 596,667 francs. During the term of the year immediately following this reduction, the number of those telegrams reached 374,321, producing a sum of 623,480 francs. Since then, this increase has grown larger and larger; the number of private telegrams exchanged between France and Algiers, which in 1877 amounted only to 118,663, has reached in 1883 a total of 540,752, or an increase of 442,089, equal to 356 per cent.

Because of this enormous increase in the traffic, we were compelled to ask the Chambers to vote us the necessary credit for the laying of a third cable.

A credit of 1,600,000 francs placed at our disposal enabled us to execute this important work. The adjudication took place on the 18th June, 1880, and the cable was laid, with complete success, on the 3rd October, 1880, and opened to the public service on the 6th October.

We have further obtained from the Eastern Telegraph Company the renouncement of their privilege of free transmission through France of telegrams exchanged between England and the East, which had been granted to them by the convention of the 12th August, 1876; they now pay for those messages a transit price of 5 centimes per word.

This company has also undertaken to transmit over their Marseilles-Bona cables telegrams exchanged between France and Algiers or Tunis, at the rate of 5 centimes only, instead of 5½ centimes per word, whilst Government messages are allowed a reduction of one half of the rates.

These modifications in the previous state of affairs represent to us a yearly increase in receipts of about 100,000 francs; they have been obtained without the Administration having had to make any sacrifice; the company have only reserved to themselves the right to recant those modifications, and to put the previous arrangements again into force, should, under certain conditions, a competition be established with the service of their lines.

Through the laying of the two cables to Algiers, of the cable to Corsica, of a cable between La Calle and Bizerta, of a cable between Bona and Bizerta, of a submarine communication between Soussa, Sfax, Gabes, Djerba, and Zarzis, and by laying some coast cables, our submarine system has been increased, in six years, from 1,324 kilometres to 4,534 kilometres, or by 535 kilometres per annum.

It should be observed here, that from 1871 to 1877 the submarine system had only been increased by 195 kilometres.

We also wish to recall to mind that on the 7th January, 1879, M. Pouyer-Quertier, acting in the name of an anonymous company formed for the laying and working of submarine lines, has been authorised to land one or several Trans-Atlantic cables, connecting France with North America. The first cable, laid by that company between Brest and New York, was completed on the 22nd January, 1880, and opened to the traffic. The public has thereby gained a remarkable reduction in the price of telegrams exchanged with America; from 3 francs 75 centimes per word, the tariff has been considerably lowered, because of the competition between the English companies and the French company; it is at present 2 francs 50 centimes per word.

The telegraphic relations between France and America have thus been improved.

The company is a French one, and it rests with the Government to see that it remains French; this should be kept in view.

Previous to the concession for this cable, France did possess already an Atlantic cable between Brest and New York, originally conceded to a French company, but who had since sold their rights to an English company, the Anglo-American Telegraph Company, to whom belong the cables between England and the United States.

The Anglo-American Telegraph Company, for the transmission of messages for which no route is given, possess a right of preference at equal prices. This privilege expires on the 1st September, 1889.

A request for the concession of a third Atlantic cable has been made to us, and we may expect that another telegraphic communication will soon be established between France and America.

Senegal is not yet connected with the general telegraph system. This causes an unfavourable situation for that colony, especially in its relations with France.

The Chambers, however, have voted a credit of 1,700,000 francs to fill up this gap, and have also approved of the contract made with the company, to whom belong the cable from Cadiz to the Canary Islands, and who for that sum have undertaken to lay, to maintain, and to work during 25 years, a cable from the Canary Islands to Senegal.

At the end of 25 years the cable becomes the property of the Administration; up to that date, although exempt of all costs of working and maintaining the cable, we receive a third of the amount of the rates between France and Senegal.

We have given our co-operation to the Ministry of Marine and Colonies for the laying of a submarine cable between Cochin-China and Tonquin, as authorised by the law of the 23rd December, 1883.

We were obliged to address ourselves for the establishment and the maintainance of this line to a foreign company—the Eastern Extension Telegraph Company. The cable, however, will be worked by officials of the French Telegraph Administration.

Unfortunately, we have not got in France a single company possessing a complete establishment for submarine telegraphy.

Besides, the Eastern Extension Telegraph Company, who possess several cables in the extreme east, alone were able to lay this cable at a cheap rate, the more so, as in order to be sure of its maintenance it is indispensable to keep on the spot ships specially fitted out to allow of the repair without delay of any accidents that might occur; should the ships required for such repairs have to be sent from Europe, the interruptions might last for several months.

A previous contract, dated the 11th July, 1883, had appeared to the Chambers to require alterations, and this delayed for a few months the date on which the cable was laid.

The laying of this cable will give cause to a yearly subvention of 265,000 francs during twenty years, to which sum should be added the costs of working it, estimated at 50,000 francs.

But the produce of the messages transmitted over the cable, and the reduction of one-half of the rates for all Government messages forwarded over all the cables belonging to the company, reduce the yearly expenses to 230,000 francs, of which amount Cochin-China will pay 115,000 francs as its share

Besides the cables we have mentioned, our submarine system consists of ten other lines.

The cable from Marseilles to Barcelona connects us with Spain.

Another one from Calais to Fano secures our relations with Denmark.

The six cables which connect us with England are laid as follows: two between Calais and Dover; the others from Boulogne to Folkestone, from Dieppe and Havre to Beachy-Head, from Coutances to the Channel Islands, and to Plymouth.

Finally, two cables, from Poulizan to Salcombe, and from Déolin to Porthomme, are reserved for the transmission of telegrams from England, which have to be forwarded by the cables from Brest to New York, and *vice versâ*. In case of interruption or insufficiency of the French cables, they allow our telegrams for the United States to be forwarded *viâ* England, without any extra charge.

The authorisation to lay these several cables has been conceded according to the terms of contracts, unfortunately very different in their exigences.

By a contract, dated the 2nd January, 1859, and a subsequent contract of the 2nd January, 1861, the privilege for the transmission of telegraph messages between France and England has been granted to the Submarine Telegraph Company. Consequently, the Government cannot lay any new cables between France and England before the 2nd January, 1889, when the present concession expires.

The importance of the laying operations of the submarine cables, which we had to undertake, tended most particularly to call our attention to the conditions on which the Administration could obtain the necessary cables.

This industry, which is almost entirely in English hands, is not practised in France but in a very restricted number of works. On the other hand, speculation has secured the trade in gutta percha, a material essential to the manufacture of cables.

Because of the high price of this product, adulterated guttas are frequently made use of to the great detriment in the insulating qualities of the cables; in any case the quality is very variable. Finally the risks of the laying operations are very considerable.

We were therefore of opinion that for large undertakings, such as the establishment of submarine lines between France and Algiers, it would be to the interest of the French Administration to make the contractor himself lay the cable which he had supplied; in this way we left to him the responsibility of any accidents that might occur during the laying.

The Administration further imposed upon him the obligation of a guarantee during a fixed period.

We proceeded on this principle to the adjudications for the two submarine lines which have thus been established between Marseilles and Algiers in September, 1879 and in October, 1880.

Each of those cables has been laid by the contractor, following a route selected by our engineers, who also pointed out the landing places.

Those cables, manufactured in the usual manner, answered to mechanical and electrical conditions which had been plainly determined by the specifications.

The contractor had further to supply the batteries as well as the testing and speaking instruments required at the two ends of the lines. That material has remained the property of the State.

The manufacture of the cables had been looked after at the works of the contractor by officials delegated for that purpose.

The costs of this control, as well as those for superintending the shipment, laying and final acceptance of the cable had to be paid by the contractor. The amount of those expenses has been deducted from the sums due to him.

Although we have not had to interfere during the operations of the laying of the cables, our Administration was each time represented on board of the ships of the contractor by engineers, whose duty it was to see that the cable payed out did not contain any defective parts, and answered to the required electrical conditions.

After the laying our engineers have taken the necessary tests to assure themselves of the good working of the cables, and they accepted the lines, but with the reserves of the guarantee-times, fixed at six months from the date of the completion of the laying.

All these operations have been executed by an English firm, the India Rubber, Gutta Percha and Telegraph Works Company, of London. We could not get French firms to take part in the adjudications which took place.

Private industry, indeed, does not possess, in France, any complete establishment for submarine telegraphy. The precautions which it is indispensable to take for the preservation of the core of submarine cables, and the practical means to pay them out to the bottom of the sea, require that they should pass direct from the works into the tanks of the ships from which it is intended to lay them. Now the two principal French firms fitted up for making cables, have their works near Paris, and, as they have neither staff or ships for the laying, they cannot undertake the work of establishing a submarine communication. They only supply ordinary subterranean cables for crossing towns, &c.

(To be continued.)

A NEW TYPE OF A LIGHT SUBMARINE CABLE.

WE know what an important part the weight of the conductors plays in submarine telegraphy. It appears not merely as a heavy item in the outlay, but as one of the principal factors in laying down the lines and in taking them up in case of damage.

As regards the outlay it is plain, writes M. Henry Vivarez in *La Lumière Electrique*, that the heavier the cable, the greater must be its cost. We must remember, besides, that with the increased weight of the line, the dimensions of the ship in which it is stored, and the power of the apparatus for uncoiling and submerging it must be increased likewise.

It is scarcely needful to insist on the facilities in laying which result from the use of a light cable. It is especially when the cable, after being laid, has undergone damage which must be repaired, that the influence of weight is shown in the most serious manner.

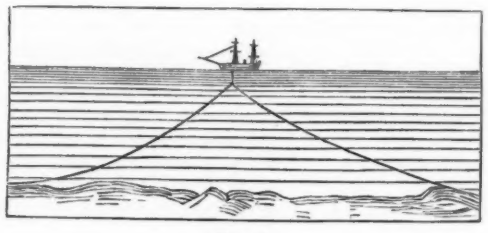


FIG. 1.

In laying a cable we are obliged to reckon on a greater length than that which is calculated from the soundings. This excess of length, technically known as "slack," does not exceed 10 to 12 per cent. of the length and cannot be less than 8—10 per cent.

This slack plays an important part in the operation of raising. When the conductor is in the act of being raised, the grappling-irons which lift it have to resist not merely the vertical component of the weight of the cable (which depends merely on the depth, and which is double on account of the two parts which extend on either side of the grappling-irons), but also the considerable efforts resulting from friction against the sheet of water intersected.

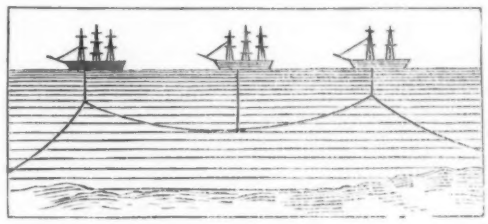


FIG. 2.

It thus happens frequently when working at great depths that the conductor may be exposed to a strain greater than what it is able to bear, and we are forced to have recourse to stratagems to bring it to the surface.

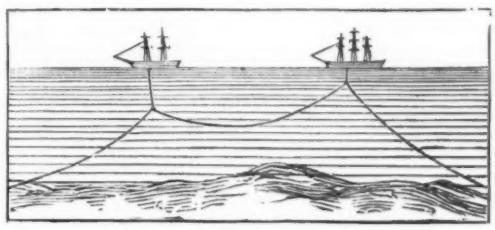


FIG. 3.

These artifices consist in the use of two or more ships in raising, which is done as shown in figs. 2 and 3, or, in the most simple cases, with the aid of an auxiliary buoy, as in fig. 4.

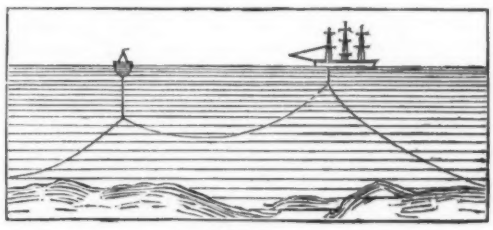


FIG. 4.

In any case we see that the difficulties and, of course, the cost, of raising must be considerable.

Hence, to decrease the weight of the cables would be an important step in advance.

If the weight is in general very great it is because the copper core does not take any part in the strain which the entire cable has to resist. We know, indeed, that copper cannot bear a breaking strain greater, at most, than 28 kilos. per square millimetre.

Besides, it is elongated by a very considerable fraction of its initial length, and if the core were made to take part in any manner whatever in the strain which the entire cable has to support, it would be drawn out beyond its limit of elasticity and would remain permanently elongated whilst the substances in which it is enclosed would return to their natural length.

It would result that being no longer able to find room in a sheath which had become too short, the copper wire would take a sinuous form in its gutta percha envelope and would occasion at certain points

true ruptures, the effect of which would be to decentralise the wire, to perforate the layer of insulating matter, and finally to open out a fault in the cable.

It is easy to ascertain by experiment that this is what actually takes place.

But there exists an alloy which can be drawn out into wires having a conductivity equal to that of copper and a mechanical resistance equal to that of the best iron. The use of this alloy would render it possible to set free the coating of the cables from a part of the strain which it now has to resist, and to diminish consequently the dimensions and the weight.

We refer to M. Lazare Weiller's wires of silicium bronze, which are now much used for electric transmissions of all kinds.

M. L. Weiller manufactures at present wires having a conductivity of 97 to 99 per cent. of the standard which at 0° C, and with the diameter of a millimetre, has a resistance of 20·57 ohms per kilometre.

These wires do not break with a less strain than 45 to 48 kilos. per square millimetre, and—which is a very precious property—their increase in length at the moment of rupture does not exceed 1 to 1½ per cent.

Wires of this alloy may therefore be advantageously substituted for those of ordinary copper, since with an equal conductivity they have a much greater mechanical strength, and they have not the defect of becoming elongated by a weight less than that of their breaking strain.

Their novel application in the manufacture of submarine cables can not be better shown than by an example.

Let us consider the deep-sea section of cable of the French Company from Paris to New York, the so-called "Pouyer-Quertier" cable constructed and laid in 1879 by Siemens Brothers, of London.

The respective weight of each of its component elements is per nautical mile.

Copper core	220 kilos.
Gutta percha	180 „
Hemp, or an equivalent ...	80 „
18 wires of galvanised iron of 2 millimetres in diameter ...	860 „
External hemp and composition	400 „
	1,740 kilos.

Total diameter, 30 millimetres. Total mechanical strength 3,000 kilos., the wires of the covering being supposed to be of iron.

Weight under water, 450 kilos.

It can support its own weight without breaking for a length of 6 to 7 miles.

Let us now examine the chart of the submarine depths.

The Atlantic presents from north to south, and at about an equal distance from each continent, a sort of longitudinal ridge, in which the depths vary from 300 to 400 metres. This ridge spreads out in 50° N. lat. into the region which has received the principal wires connecting England and France with the United States. On both coasts there are depressions in which the bottom is at the depth of 4,000 to 6,000 metres. The one on the east extends from the south point of Ireland to the latitude of the Cape of Good Hope, and its left-hand boundary follows the general outlines of the west coasts of Europe and Africa.

The two others, the north-western and the south-western, form two basins, bordering respectively on the United States and the Antilles and South America.

In these depressions soundings have shown certain zones in which the depths exceed 6,000 metres. The principal are found to the west of the Canaries, to the south of Newfoundland, between Porto Rico and the Bermudas, and to the right of the Isle of Marten-Vaz.

The great depths of the Pacific are differently distributed. Between Japan and California, longitudinally between 40 and 50 N. lat., there is the Tuscarora depression, which has depths of 6,000—8,000 metres. Parallel to Japan and the Kuriles there is a depression, in which has been found the greatest known depth—8,513 metres.

We see, therefore, that any new great submarine line having to extend into another zone than that which has received the present Atlantic cables must traverse depressions in which the bottom reaches a minimum depth of 4,000 metres. The possibility of raising a damaged cable would be very problematical under such conditions, and it would become certainly impossible in case of a cable from San Francisco to Japan.

Under these conditions we are forced to conclude that the use of the present cables limits strikingly the progress of submarine telegraphy, which must remain confined to certain zones of the Atlantic, to inland seas, and to lines along the coasts.

But if we consider the daily progress of applied science, and the constantly increasing demand for rapid communication between nations, it is certain that we must shortly undertake the study of new cables intended to traverse the greatest depths of the ocean for long distances. Necessity, therefore, compels us to investigate the new solutions which may furnish us with light cables, easy to lay and possible to repair.

M. J. Richard, former director of the Administration of Telegraphs, and at present Administrator of the General Telephone Company, has solved the problem by introducing in the manufacture of cables Weiller's silicium bronze, and the especial competence which he has acquired in a career almost entirely devoted to submarine telegraphy, leads us to consider his solution of the problem as likely to receive, in the immediate future, the sanction of experience.

M. Richard's cable is composed as follows :—

Core of silicium bronze equal in weight to that of the "Pouyer-Quertier" cable, or per nautical mile	220 kilos.
Gutta percha	180 „
Layer of hemp	80 „

The sheathing is formed of 28 wires of galvanised iron of 1·25 millimetres in diameter, each covered with hemp, and all twisted into a rope around the dielectric.

The wires	500 kilos.
The hemp covering them ...	250 „

The weight of the cable is, therefore, 1,230 kilos in the air and 320 kilos. in the water.

Its diameter is 25 centimetres, and its resistance to fracture 2,800 kilos., of which the core supports one-half.

Under these conditions the cable can support eight to nine nautical miles of its length, and can be raised up from the greatest depths.

The results of this comparative examination are self-evident.

For an equal conductivity and an approximately equal mechanical strength the new cable is in weight and bulk equal to about two-thirds of the Pouyer-Quertier cable.

It would cost about £33 less per mile, and would require for laying a ship and engines of less power, and, therefore, cheaper.

This will be the type of deep-sea cables. In the regions where reigns absolute immobility, where life is rare, the reduced armature will suffice to resist friction and the attacks of animal life.

For the shore ends we must keep to the types generally employed.

The model of which we speak is the first which has been manufactured. Such as it is, and although it may undergo modifications in detail from a more complete study and from experience, it merits the attention of competent engineers.

Telegraph Revenue.—The receipts into the Exchequer from 1st April to 5th July of the present year were £440,000, against £435,000 for the corresponding period of last year. The estimate for the year is £1,800,000.

REVIEWS.

The Practical Telegraphist and Guide to the Telegraph Service. By WILLIAM LYND. London: Wyman & Sons, Great Queen Street, Lincoln's Inn Fields.

The object of this work is to afford information to those who wish to enter some branch of the telegraph profession as operators. Although in the Government service no one can enter before or after the respective ages of 14 and 18, and even then only by an examination, and, finally, by a course of training conducted exclusively by the department, yet there are always a large number of appointments open to those who are willing to work in country and sub-country offices as unestablished clerks. To persons seeking such appointments Mr. Lynd's book must prove very useful, and those who wish to know something more than the mere outline of their profession may certainly obtain this by reading the work, as the latter contains a large amount of practical information on the instruments, batteries, &c., used in telegraphy. A considerable amount of the information given is general, which considerably increases the utility of the work and renders it acceptable to those who, although not desirous of becoming operators, yet take an interest in the subject of telegraphy. A directory concludes the work, but this portion, we regret to say, has been somewhat carelessly compiled, as errors are very numerous.

Telegraphy. By W. H. PREECE, F.R.S., and J. SIVEWRIGHT, M.A. Third edition. London: Longmans, Green & Co.

This book is so well known that it is unnecessary to refer to its various chapters in detail. The original edition consisted of 300 pages, the present one has 328, but this does not actually represent the amount of new matter which has been added, since obsolete information has been weeded out. The new portion of the book consists principally of chapters on "The Telephone," "Fast Repeaters," and "Quadruplex Telegraphy." All points of detail in connection with these subjects (as at work in the Post-office) are well explained and sufficiently illustrated.

NOTES.

Electric Lighting.—The Anglo-American Brush Electric Light Corporation has lately received an order from the Australasian Electric Light, Power and Storage Company (its concessionaire for Australasia) for a large quantity of incandescence apparatus. The machines ordered are five F_2 Victoria 250-light machines, and one D_2 100-light Victoria machine, and with these a large number of new Victoria 20 C.P. incandescence lamps. This plant, or at least the greater part of it, will be used for lighting the Houses of Parliament at Melbourne.

The tanneries of Messrs. Astroin Bros., of Uleaborg, Finland, are about to be lit throughout by means of the incandescence apparatus supplied by the Anglo-American Brush Electric Light Corporation. The plant will consist of one D_2L Victoria machine compound wound, 80 20-C.P. and 80 10-C.P. lamps, and the necessary fittings and cable. The whole work of the installation will be superintended and carried out by the Corporation, which is about to send an assistant engineer over to Finland for that purpose.

The International Health Exhibition, which is being held at South Kensington, has a large portion of the buildings and grounds lit by arc and incandescence apparatus supplied by the Anglo-American Brush Electric Light Corporation. The number of arc lights used is 25, that is, including the two lamps in parabolic reflectors, used for throwing light on to the main fountain when playing; these two lamps being mounted on the roof of the central gallery. The lamps are of the ordinary well-known Brush 16-hour 2,000 C.P. nominal type for indoor use; they are fitted with brass covers and crowns, whilst for outdoors they are placed in hexagonal lanterns. The chief feature of this exhibit is the Brush machine driving these lights. This is of the well-known No. 7 type, but is fitted with one of Mr. Brush's new patented armatures, which is the property of the Corporation, and it is the first time this armature has been publicly exhibited in this country. The old No. 7, 16-light machine fitted with this armature, is capable of doing 50 per cent. more work than when fitted with the old one; for example, the machine at the Health Exhibition is *always* running at least 23 lamps and sometimes 24, but is the 16-light size, the employment of the new armature enabling it to produce the above result. Perhaps the most notable feature of this armature is its absolute coolness when the machine is running, and after a long run. Among the buildings and exhibits illuminated by the arc apparatus, we may mention the East and West Annexes, the Central Annexe, and Messrs. Clements and Co. The incandescence plants of the Corporation are three in number, one of them, consisting of 100 60-volt lamps, is exclusively used for illuminating the exhibit of the Dowson Economic Gas Company, Limited. The machine used here is a D_2 compound Victoria machine driven by one of Messrs. Crossley's new double cylinder Otto gas engines, the gas being supplied by the Dowson Gas Company for working the engine. The other installation consists of 100 100-volt lamps, which are distributed in different parts of the Exhibition, a number lighting up Lockhart's cocoa rooms and oyster divan, and others being used in the refrigerating chambers in the Western Annexe. The machine used for this installation is also a D_2 machine, but, in this case, is wound to give an E.M.F. of 100 volts. The engine driving the machine is one of Parson's high speed direct-acting engines, manufactured by Messrs. Kitson and Company of Leeds, which is remarkable for silence and freedom from vibration in working. The lamps used in both of the above installations are of the new Victoria type, which of late have undergone considerable improvement in manufacture, and for these the Corporation claim a very high efficiency. A second D_2 machine similarly wound to the above will be attached to Tower's high speed spherical engine, constructed by Messrs. Heenan and Froude, engineers, of Manchester; this will operate a number of lamps placed in different parts of the Exhibition.

The Gas Company at Leipzig intends, says a contemporary, to ask the Municipal Council of that town for a concession for lighting the streets and houses by electric light.

Mr. Milner, of the Woodside Flour Mills, has introduced the electric light into his premises, so that the mill is now one of the most complete for corn grinding to be met with in the north of England. As the mill is run day and night, the introduction of electric lighting will, it is believed, prove to be an immense advantage in many ways. The experiment was tried for the first time on Thursday the 3rd inst., and was found to work admirably, the lamps giving out a clear, steady, and brilliant light. The installation consists of one Crompton-Burgin compound self-regulating dynamo machine, and some 76 20-candle power Swan incandescent lamps. It is intended that there shall be an arc lamp on each side of the mill, for loading purposes; these will be of the well-known Crompton-Crabbe type, of 2,000 actual candle power. The question of reducing fire risk in corn mills is especially interesting. The loss by fire in corn mills has increased from £42,000 in 1877 to £154,000 in 1883, and this has resulted in the insurance companies raising their rates of premium. The adoption of the electric light, however, will, it is believed, be a great step towards reducing this risk to a minimum. The work has been carried out under the superintendence of Mr. J. T. Baron, on behalf of Mr. Wilson Hartnell, electric light contractor, of Leeds, who recently lighted up the new mill of Messrs. James Clay and Sons, Luddenden Foot.

That the proprietors of the Manchester hotels do not intend to be behind the times in the matter of their illumination is evidenced by the fact that the owners of the Clarence Hotel have just placed a lighting contract in the hands of Mr. F. D'A Goold, electrical engineer and contractor. The plant will consist of the necessary machinery capable of running 200 incandescent lamps. The contract for the lighting of the Waterloo Hotel has also been given to the same gentleman. The plant at this hotel will be for the same number of lights as the above.

Wellington House, Glasgow, one of the largest drapery warehouses in Scotland, has been lighted up with the electric light. The plant consists of 12 "arc" lamps of the Clarke and Bowman type, for which the current is supplied by two of Paterson and Cooper's "dynamos." The fitting up of the installation was under the superintendence of Messrs. Paterson and Cooper's agent for Scotland, Mr. James Campbell, of Glasgow. The prime motor used is one of Messrs. L. Sterne & Co's. 12 H.P. gas engines (Clerk's patent).

Mr. Charles Batchelor, who has been engaged in developing the Edison system in Europe, states that the contracts on hand at the factories on the Seine are more than the 400 employés can carry out at present. Mr. Batchelor proceeds :—The French company is completing a 20,000 light circuit for Paris. It covers the very heart of the city, the Rue de l'Opera, and other points which have heretofore been unsuccessfully attempted to be covered, by the best class of arc lights. The company has lighted already the Hôtel de Ville, or City Hall, and has over 6,000 lights in the Grand Opera House, 2,000 in the Eden Theatre, 1,200 in the Comique, 1,200 in the Vaudeville, and 1,200 in the Grand Hotel. Mr. Batchelor thinks it a fair estimate to say that the contracts of the company now cover about 26,000 private lights to which no power is furnished, but only the globes, &c. There are 600 lamps in La Nouveauté, 500 in La Varieté, 500 in La Bouffe Parisenne. They are to be found in all the *cafés* from the Madeleine to the Varieté, and as far north as the Gare St. Lazare, and as far south as the Hôtel Continental. Through all this district, the most important in the city, the company has the option of the right of way for all private lighting purposes on the payment of two and a-half million francs, and its rights are guaranteed by the Government. It will require a company of 3,500,000 francs capital, and there are capitalists willing enough to go in for larger amounts than that. The whole matter will, however, go into the hands of the Compagnie Continental, which will take care of and assume all the patents and pay to the company 80 per cent. of all the profits above 6 per cent. upon its original capital stock. This company was organised under the Compagnie Continental Edison, which owns all the electric lighting patents for Europe, the Edison Electric Light Company of Europe, Limited, and Compagnie Electrique Edison. The Compagnie Continental has a paid up capital of 3,500,000 francs, of which one-half has already been expended in factory and tools, and it is engaged in laying out its work all over Europe. There remain nearly 2,000,000 francs with which to go into a new business, while Paris is willing to contribute another 3,000,000 of francs for its own purposes, thus giving, with offers from other sources, a capital of 6,500,000 francs, of which it is proposed to expend 3,500,000 in new works. At Ivry-sur-Seine the company is making 800 lamps a day, and all are sold before they are made. Mills are being lighted all over France under the Edison patent, the company furnishing only the globes and making the adjustments. The French company has made a contract with the Germans for 5,000,000 francs for the right to use all the Edison rights. Siemens and Halske, the great German manufacturers, have a sub-contract with the original owners by which they agree to pay a royalty for every incandescent lamp which they make, whether the lamp be of the Edison, Swan, or Siemens patterns, since they are used in connection with the Edison system. A good start was obtained from the expositions at Munich, Vienna, Paris, and Nice. The exhibition at the latter place was, Mr. Batchelor thinks, a great failure, despite the government backing, but they lighted the buildings independently and on their own account, and it paid them. Their plant is now being negociated for by the proprietors of Monte Carlo. Arrangements are being made to light the Nevski Prospect, in St. Petersburg, the handsomest street in Europe. Contracts are pending for lighting a district in far away and unusually slow-footed Finland, where people do most of their travelling on sleds, and where there are scarcely 500 miles of railroad. They have contracts for the Hof, or Residence, and Imperial Theatres at Munich, under the special direction of King Louis of Bavaria. Strasburg and Rotterdam are under contracts with the Edison company, and the Austrian companies already organised have capitals of 60,000,000 gulden ; while a special company is organising in Berlin. The Edison patents cover all the countries where patents are granted.

The Anglo-American Brush Electric Light Corporation, Limited, has just issued a circular, in which it is stated that as an impression seems still to exist in some quarters that the corporation confines its operations, almost exclusively, to the "arc" system of electric lighting. The present moment is, therefore, thought an opportune time, when the corporation is issuing a new-priced catalogue of its various machines and apparatus, to point out that so far from this being the case, the corporation has always most fully recognised that the "incandescence" system and the "arc" system has each its proper field of development. The corporation has now for a considerable time been in possession of an incandescence lamp which is believed to be by far the best lamp in the market ; and as the result of a long series of carefully considered experimental work, the corporation has more recently been placed in possession of a specially designed dynamo for incandescence lighting, suitable in every way to meet the large demand that has arisen for such machines. This dynamo, named the "Victoria," which has been described and illustrated in our columns, gives a return in electrical energy, in the larger sizes in which it is made, of as much as 96 per cent. of the mechanical energy expended on it. For the "Victoria" dynamo it is claimed that the material is so judiciously employed, all iron work is so made use of both magnetically and mechanically, and the frames so braced together, that there is no racking, and it can be erected without a bed plate. The bearings are made very long and true, to avoid wear and heating, loss of energy is avoided both by making the commutator and all the electrical fittings large and massive, and sparking at the commutator is reduced to a minimum by the arrangement of the pole pieces. Simplicity is further obtained by means of the patented system of connecting the bobbins, by which means no more than one pair of brushes is ever required. The system of compound winding adopted by the corporation is claimed to be perfect, since a dynamo running at a constant speed will run one lamp with the same degree of incandescence as it will run the maximum number of lights for which it is made ; in other words, any number of lights can be turned on or off without any regard whatever being paid to the dynamo machine, which continues to run at its normal speed, while the power absorbed by the dynamo remains at all times practically proportional to the number of lamps in action.

The *Electrical Review* of New York states that despite all that is being said by the newspapers, the number of arc lights in use in America is steadily and rapidly increasing. Several New England cities are making extensive additions to existing plants, and a number of wholly new plants are going in.

The Telephone in China.—The telephone exchange at Shanghai has been transferred from the Oriental Telephone Company to the China and Japan Telephone Company, Limited, as well as the small exchange at Hong-Kong, which had been closed temporarily for want of public support.

The Melbourne Telephone Exchange.—The improvements now in progress in Melbourne promise to give that city one of the best-equipped telephone exchanges in the world. A new building has been constructed by the Telephone Exchange Company, on freehold land bought by them for the purpose, about half-a-mile from the old office in the Melbourne Exchange, and so chosen as to make the new office as nearly as possible the centre of the square formed by the city. The principal feature of the new office is the switchboard, which is the "Multiple" now so largely used in America, and already to some extent in Europe. The Melbourne switchboard is mounted complete for 1,000 subscribers, although the exchange has only three-fourths that number at present. So confident are the managers of the company in the growth of their business, that they have made the switchboard with an ultimate capacity for 3,000 subscribers. As now fitted up for 1,000, the switchboard consists of five sections, for 200 lines each. As some of our readers are aware, the peculiarity of the "Multiple" system consists in bringing every wire in the entire exchange, whether 500 or 5,000, to each section of the board; so that every operator has the entire number of subscribers within his reach. The economy thus effected in the number of employés and in the time required for making connections, is really wonderful. This system has recently been introduced at Liverpool, and we hope shortly to give a full description of the installation there. The transfer of the wires from the old office to the new in Melbourne is a work of no ordinary magnitude. To carry some 700 wires through the streets for half-a-mile was out of the question; so it was decided to lay lead-pipe cables underground, and the required amount of cable, of the Patterson form, is now on the way to Australia. The work is being carried out by Mr. Draper, superintendent of the company, assisted by Mr. Warner, of the Western Electric Company.

The Telephone in Nottingham.—The *Nottingham Daily Guardian* gives a detailed description of the progress of the telephone in that town, and from its article we gather the following information:—The National Telephone Company opened an exchange in Nottingham in September, 1881, the first line being put up on November 1st. At the end of that year 25 subscribers had been put into communication, and there was an average of 250 calls per day. The exchange has now 140 subscribers, the average number of calls being 1,000 daily. Over 350 miles of wire have been erected within a radius of 14 miles. The local branch of the company has also constructed lines at Burton-on-Trent, Louth, and Cromford, and is anxious to extend into other parts of Derbyshire, Lincolnshire, Leicestershire, and Notts. An endeavour has been made to establish communication between Nottingham and Loughborough, but as there is opposition from private sources that object has not yet been achieved. The corporation has availed itself to the full of the new means of communication, all the police stations and the public offices associated with the various departments being linked to the exchange, and to one another. The electricity required is generated by water force, and Gilliland's switch boards are in use, never having failed during the two years they have been in operation. The relations of the company with the Post Office are stated to have been most harmonious, but relating to the pamphlet published by the United Telephone Company upon the subject regarding which that company and the Post Office are at issue, the *Guardian* says:—"The company complain bitterly of the conduct of the Post Office in impeding their action, and, indeed, so strong a case is made out, that the pamphlet requires an answer."

Telephony in France.—The French Minister of Posts and Telegraphs has stated that he intends shortly to introduce the Van Rysselberghe system between Havre and Rouen.

The Telephone as a Fire-Alarm.—Another striking instance of the utility of the telephone as a fire-alarm, states the *Edinburgh Courant*, was afforded at Kirkcaldy on June 30th. A few minutes before one o'clock on that day the factory of the Kirkcaldy Linoleum Company at Sinclairtown was discovered to be on fire. Advantage was instantly taken of Messrs. Shepherd and Beveridge's connection with the telephonic exchange to notify the fact to the police and fire brigade station (which is also connected), situated about one-and-a-half miles from the threatened factory. No sooner was the intelligence acknowledged by the fire brigade, than Messrs. Shepherd and Beveridge caused themselves to be connected successively with Messrs. Nairn and Co. and other firms on the telephonic exchange known to possess private fire-extinguishing appliances. The assistance asked for was so promptly rendered that Messrs. Nairn & Co.'s apparatus was on the spot and at work within seven minutes of the receipt of the alarm by them. The apparatus of several other firms arrived in quick succession, and last of all, owing to the distance it had to traverse, the Kirkcaldy fire brigade. The combined efforts of the forces thus assembled by the telephone proved so successful that the fire was confined to the upper flats, the main portion of the extensive factory—a part of which is quite new—being saved. Had there been no telephonic exchange in Kirkcaldy, the alarm could only have been given by foot messengers, and the total destruction of the building and its contents must have resulted.

The Post Office and the Telephone.—It is stated that the proposal to establish telephone communication between Edinburgh and Glasgow has been given up, because the terms were so onerous that only one or two firms were willing to accept them. The *Scotsman* thinks it is possible that a way out of the difficulty existing in regard to the relations of the Post Office with the telephone companies may yet present itself, but without legislative sanction the Postmaster-General cannot shake himself free of the obligations which the conservation of the telegraph revenue imposes.

Cable News.—The managing director of the Brazilian Submarine Telegraph Company, Limited, announces the successful laying of the second cable between St. Vincent and Pernambuco, thus completing the duplication of this company's entire system between Europe and South America.

It is notified that the Eastern Extension Company's system has been extended to Macao by the laying of a submarine cable between that place and Hong Kong. The tariff from all stations in Great Britain is 8s. 9d. per word.

The Spanish-American Cable.—The company formed for the purpose of laying a cable between Ceara and the United States has been authorised by the Emperor of Brazil to take the name Dom Pedro II. American Telegraph and Cable Company.

Divulging War Telegrams.—The case of the Central News Company *v.* the Eastern Telegraph Company and others came up for further consideration before the Lord Chief Justice, on Saturday. A lengthened hearing recently led to the finding by the jury that the defendants had taken their message of the victory at Tel-el-Kebir "indirectly" from a message sent to Sir E. Malet by Sir Charles Wilson, who had derived his information from a telegram dispatched by the correspondent of the Central News to the office of the latter in London; the jury also found that the defendants did not divulge the plaintiff's message to their damage. After some argument upon the question of misdirection, Lord Coleridge, on Saturday, gave judgment for the defendants, leaving the plaintiffs to move for a new trial for misdirection.

Remarkable Feat in Telegraphy.—"J" writes to the *Times*:—"On Tuesday last I sent a telegram from East Croydon to Westminster at 20 minutes to 10 a.m.,

and it positively reached its destination at Bridge Street seven minutes under the hour—*i.e.*, at 10.33. I arrived there myself (by train) at 10 minutes past 10, and thus I was enabled with a little patience to witness the arrival of my own telegram 23 minutes later. A few days ago I sent a telegram from East Croydon to Brighton, and that arrived almost in the same time. If things go on at this rate I would suggest the desirability of someone presenting a testimonial to the telegraph authorities, in order to stimulate them to still greater exploits."

Upon a somewhat similar subject, "M" writes to the *Times*, July 4th :—"Last evening an important telegram was handed in at the House of Commons office at 8 o'clock. It reached me in Cornwall Gardens a few minutes after 9. To-day I myself put in one at the same office, which it was equally important should reach the City in a few minutes. The clerk retained it in his hand and went on receiving others. I begged him at least to hand mine to the operator, whereupon he calmly replied, 'Oh, that is no use ; there are several before yours.' I took it and my money back, and sent a messenger. If this sort of thing can happen from important centres, is not telegram sending rather a farce ?"

Photographing a Flash of Lightning.—The accompanying engraving was made directly from a photograph sent to us by Mr. W. C. Gurley, of Marietta Observatory, who writes as follows :—"The reproduction of a flash of lightning by photography would, a few years since, have been deemed quite an impossibility, but the introduction of the rapid bromo-gelatine process has rendered it not only possible but comparatively easy of accomplishment. The accompanying photograph is from a negative taken by myself during a thunderstorm which passed several miles south of the observatory on the evening of May 4th. Wheatstone has demonstrated by direct experiment that the duration

of a single flash of lightning cannot possibly exceed a millionth of a second. That a photograph showing the detail of the one mentioned could be taken in this inappreciably short time seems quite wonderful, not to say incredible. The plate employed was one of Cramer's extra rapid, and developed with strong pyrogallic developer. It will be observed that the flash is not of the usually depicted zigzag form, and that it seems to be alternately contracted and expanded in its passage through the atmosphere. Taking the interval between the flash and the report I estimated its distance from the camera to have been about five miles."—*Scientific American.*

A Proposed Magnetic Observatory.—The Italian Government proposes to found a central magnetic observatory at Rome, to be placed under the direction of the Meteorological Office. The Government asks for a vote of 176,000 fr., in addition to an annual sum of 5,550 fr. for general expenses, and 11,500 fr. for *personnel.*

Brook's System of Underground Wires.— Brook's Company, in Philadelphia, has offered the municipality of that city to undertake the contract of laying all the telegraph and telephone wires belonging to the public services underground for a sum of 175,000 francs, payable in a year, and then only when the system has given complete satisfaction during that guaranteed time. The offer of the company has not yet been accepted.

Destructive Fire.—A *Times* telegram from New York states that the Revere Rubber Works, at Revere, Massachusetts, have been destroyed by fire. The loss is estimated at $500,000.

The Electrical Power Storage Company, Limited.—Mr. Justice Kay, on Friday, upon the petition of the company, sanctioned the registration of a special resolution of the company for the reduction of its capital from £800,000 to £200,000. The evidence showed that the value of patents connected with electricity had enormously diminished since the year 1882. Mr. Renshaw appeared in support of the petition.

The Society of Telegraph Engineers and Electricians.—By permission of the Council of King's College a conversazione was held there on Friday evening, last week, of members of the Society of Telegraph Engineers and Electricians. Prof. W. Grylls Adams, President of the Society, received the guests in the entrance hall of the college, which was illuminated by incandescent electric lights, and the rooms set apart for the gathering were the libraries, the museum of physical apparatus, the physical laboratory, and the art galleries, in which a number of objects of interest were placed for inspection. To these the president himself, and two past presidents, Mr. W. H. Preece and Sir Frederick Abel, contributed. Mr. Preece showed a model of the Paris legal ohm, as settled at the Paris Congress of Electricians, as well as an apparatus illustrative of Prof. Dr. Dvorak's acoustic experiments. The other exhibitors included the Royal Microscopical Society, which sent some microscopes and objects, many private members of the society, and a number of eminent firms of electrical engineers ; and while science was well represented, a small but interesting collection of pictures, sculpture, and artistic designs sufficed to show that art was not entirely neglected. An exhibit was made under the superintendence of Mr. Latimer Clark and Mr. John Muirhead, showing the effect of retardation on an artificial cable equal to about 8,000 miles of the Atlantic cable type, at present being made for the Commercial Cable Company (Bennett-Mackay cables). This experiment was the more interesting, as the effect of retardation had never previously been shown on so long a length of cable. The artificial cable was composed of a number of Muirhead's patent inductive resistances and condensers, which form part of the apparatus for working the new Atlantic cables on Muirhead's duplex system. This system is also working the Atlantic cables of the Western Union and Direct United States Cable Companies. The effect of retardation on this length of cable, under the circumstances, was very marked, the current taking about three seconds to traverse the entire line to show a signal at the distant end. The total electrostatic capacity of the cable was about 2,400 microfarads, and the total resistance about 19,200 ohms. In addition to this exhibit there were several instruments connected with the working of the duplex also shown. At the same time Mance's new system of testing apparatus was exhibited. This has been specially designed for fault testing on cables. The instrument is of a very compact and neat form, and should simplify the difficulties experienced in

localising faults from on board ship. The apparatus exhibited was manufactured by Latimer Clark, Muirhead & Co., Limited, of Westminster.

Conferences on Electrical Subjects.—At the Health Exhibition on Friday, last week, two conferences were held under the auspices of the Society of Telegraph Engineers and Electricians, at which papers were read by Mr. R. E. Crompton, on "The Electric Light in Relation to Health," and by Dr. W. H. Stone, on "The Physiological bearing of Electricity on Health." Prof. W. Grylls Adams, F.R.S., president of the Society, occupied the chair, and the papers were listened to with much interest by the rather small audiences who attended. The discussion following each paper was sustained in an admirable and most interesting manner.

Heinrichs v. Westinghouse.—Judgment in this case, which was commenced on Monday last, was delivered by Mr. Justice North on Thursday. The plaintiff, the inventor of an apparatus for generating electricity, and of improvements in regard to electric lighting, entered into an agreement in August, 1881, with the defendant, a member of the firm of Westinghouse & Co., railway brake manufacturers, whereby the former was to complete and pay for the machines already made for the purpose of demonstrating the practicability and utility of his inventions, and proceed with those machines to Pittsburgh, in Pennsylvania, America, there to associate himself with the Westinghouse Machine Company, apply for and use his best endeavours to obtain United States patents for his inventions, assigning these patents when obtained to such company or person as the defendant might direct. For five years plaintiff was to apply himself exclusively to perfecting his apparatus, receiving a stipend of $3,000 per annum by equal monthly payments, and a royalty of 10 per cent. on all apparatus made and sold under his patents. The plaintiff now claimed damages for breaches of the agreement, as defendant did not send him to Pittsburgh as agreed, but detained him in Paris, where he refused to supply him with proper accommodation, assistance, materials, &c., and did not supply him with the monies necessary for the completion of letters patent, and the payment of the cost of materials; refusing also to pay him the stipend agreed upon. The plaintiff asked that the agreement might now be declared void, and that an injunction might be granted to restrain the defendant from in any way acting upon it, asking also for damages upon the various breaches. Without calling upon the counsel for the defendant, his Lordship held that the plaintiff had not made out his case; and, in the course of an elaborate judgment, said it was clear to him that there had been no such default as set up. He should therefore dismiss the action. Upon the matter of account, however, he was of opinion that defendant should pay to the plaintiff the sum of £126 2s., two months' stipend and incidental expenses; and he should direct that in taxing the costs credit should be allowed to the plaintiff for that sum. The costs would go with the action.

Society of Arts.—The conversazione given by the Society of Arts and the Executive Council at the International Health Exhibition, on Wednesday night, was a brilliant entertainment. The immense concourse in evening dress, the dazzling illumination of the electric light, which was everywhere seen in surpassing beauty and splendour, the multitude of bands, and the hospitality of the exhibitors combined to make it a memorable event. The company were received by the Duke of Buckingham and Sir Fred. Abel, the President of the Society of Arts, supported by other members of the Councils. The crown of the evening's display was gained by the brilliantly-illuminated fountains of the waterworks, which Sir Francis Bolton has at last got perfectly lighted by the electric light. Nothing more lovely than the brilliant glitter and sparkle of the water jets can be conceived. The gardens, lamps, and lanterns were most tastefully arranged, and the combined effects of the coloured lanterns and the coloured electric arcs upon the water pools were exceedingly fairy-like and beautiful.

Personal.—Mr. Chas. Capito, having left the Electrical Power Storage Company, Limited, has taken offices at 23, Queen Anne's Gate, Westminster, S.W., in order to devote himself to the profession of a consulting engineer. Mr. Capito gives special attention to the following subjects:—Electric lighting and transmission of power, primary and secondary batteries, &c.; bridge work and iron structures in general; reports on new inventions, evidence in patent cases, &c.

NEW COMPANY REGISTERED.

Universal Telegraphic Company, Limited.—Capital, £600,000, in £1 shares. Registered office, 34, New Bridge Street, E.C. Objects: To establish a "universal office for instruments of transmission," and to take over the telegraphic business carried on by Messrs. A. Le Marquand and J. Declem, at 34, New Bridge Street, E.C., together with the interest of M. Marquand and his co-partners in the newspaper called the *La Ville de Paris*, and in a leasehold office situate at 3, Rue d' Aboukir, Paris. Signatories, with 1 share each: *A. le Marquand, 35, Boulevard Bonne Nouvelle, Paris; *Julius Declem, 34, New Bridge Street; A. Kelday, Sydenham; W. C. Cooper, 30, Kings Arms Yard; F. W. Bull, 10, Lambert Villas, Brixton; C. Darty, 24, New Bridge Street; S. A. Lillicrap, 40, Neville Road, Stoke Newington. Directing qualification: 1,000 shares. The first two signatories are appointed directors for five years, and are to receive not less than £1,000 per annum each. Registered 4th inst., by Messrs. Champion, Robinson and Poole, 17, Ironmonger Lane, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Birmingham and Warwickshire Brush Electric Light and Power Company, Limited; Yorkshire Brush Electric Light and Power Company, Limited.—The final meetings of the shareholders in these companies were held on 25th ult., when accounts were laid before them by the liquidator showing the manner in which the winding-up has been conducted, and the properties of the companies disposed of.

Electric Writing Company, Limited.—An order of the High Court of Justice, dated 10th ult., and filed on the 2nd inst., directs Mr. John Robert Breckon, the official liquidator of this company, to affix the seal of the company to an indenture of assignment to himself of the letters patent, No. 3762, dated 25th October, 1875, granted to Thomas Alva Edison for improvements in autographic printing.

Electric Apparatus Company, Limited.—The statutory return of this company, made up to the 25th ult., was filed on the 2nd inst. The nominal capital is £12,000, divided into 600 vendors' shares, and 600 ordinary shares of £10 each. The number of shares taken up is 600, which includes 300 vendors' shares issued as fully-paid. Upon 300 shares, £2 10s. per share has been called up and paid. Registered office, Monument House, Monument Yard.

Kelway's Electric Log Syndicate, Limited.—At an extraordinary meeting of the members of this company, held at 58, Lombard Street, on the 22nd May, it was resolved to wind up voluntarily, it having been proved to the satisfaction of the syndicate that it could not, by reason of its liabilities, continue its business. Mr. Edwin James Morris, of 58, Lombard Street, was appointed liquidator. An order of the Chancery Division of the High Court of Justice, dated 26th ult., authorises the voluntary winding up.

Electric Motor Syndicate, Limited.—The first return of this company made up to the 14th November, 1883, was filed on the 4th ult. The nominal capital is

£12,000 in £100 shares. 81 shares have been taken up, and of these 60 are issued as fully paid ; upon 21 shares the full amount has been called, the calls paid amounting to £1,025, leaving £1,075 unpaid.

An order of the Chancery Divison of the High Court of Justice, dated 17th November, 1883, and filed with the documents of this company on the 4th inst, directs the winding up of the company, upon the petition of Mr. Alexander Browne, of Leconfield, Highbury New Park. The order authorises the payment of the costs of the petitioner out of the assets of the company, subject to taxation by the taxing master of the court.

Lyons Electrical Power Storage Company, Limited.—The offices of this company have been removed to Gresham House, Old Broad Street, E.C.

Removal of Office.—The Jarman Electrical Company, Limited, has taken larger and more commodious premises at Mackintosh Lane, Homerton, E., where all communications in future should be addressed.

CITY NOTES, REPORTS, MEETINGS, &c.

Eastern Telegraph Company, Limited.

THE twenty-fourth half-yearly ordinary general meeting of this company was held at the Cannon Street Hotel on Thursday, Mr. John Pender, M.P., presiding.

The notice convening the meeting having been read, and the minutes of the previous meeting signed,

The Chairman stated that the revenue for the six months to the 31st March, 1884, amounted to £345,156, against £328,404 in the corresponding period of the previous year. This increase was largely due to the expedition undertaken by the British Government in the Soudan, and the continued occupation of Egypt by the British troops, and also to the gradual development of the general traffic. The ordinary expenditure was £90,482, against £87,824 in the corresponding period of last year; an increase of £2,658, which included £2,410 for expenses as to the issue of 4 per cent. debenture stock, and the expenses in connection with the action brought against the company by the Central News, judgment in which was given in favour of the company. The expenses attending repairs and renewals were £37,113, a decrease of £13,788 upon the previous year. £65,000 had been carried to the reserve fund, making that fund £614,170. Of this amount, the directors had applied £300,000 in part payment for the Red Sea cable, and that laid between Alexandria and Port Said. The total amount of the reserve fund was, therefore, £349,777. Since the amalgamation in 1872, the ordinary working expenses had averaged nearly 26 per cent. of the revenue, and the repairs 11 per cent.; in other words, the repair of cables since 1872 had cost £55,000 per annum, or something like £3 per mile; the total working expenses, including cost of four maintenance ships, had been about 37 per cent. of the revenue. An average of £50,000 per annum had been added to the reserve. The number of stations in 1881 was 42, now there were 52; in 1881 the number of the staff employed at the stations was 419, and it had now reached 533. There were six grades or classes amongst the employés, and the average salary of each, including superintendents, was £109 per annum. There were at present 19,000 miles of cable belonging to the company, and 3,000 miles of land lines. There were some rather unfavourable opinions expressed when the directors issued the £500,000 worth of debentures; that stock was issued partly to pay off the 6 per cent. debentures and partly to pay amounts incurred in extensions. Some people thought it was a very bold thing to issue 4 per cent stock; however, he was very happy to say every farthing of that stock was taken up, and if they could have issued more they would have been able to find customers for it. New stations had been opened at Glasgow and Liverpool. There was a very extensive trade between the former port and India, and its connection with the cable had been found to be a very great convenience. Some foresight, he thought, had been displayed in opening a station at Suakin and connecting that port with their system, and they had had no reason whatever to regret the laying down of the short cable necessary; it worked well and was giving a fair return on the expenditure made; and, moreover, had made the Government feel that they could not very well do without the company. The arrangements with the Greek Government were completed, and 25 islands belonging to Greece were now being connected telegraphically with Athens. A concession had been obtained from the Turkish Government, giving the company a very strong position indeed in the Mediterranean and the Levant. A preponderating influence had been obtained in the Direct Spanish Telegraph Company, but it was thought desirable to keep the company distinct. Its system had been duplicated, for which an issue of debentures at 6 per cent. had been made, and he (the Chairman) thought they had made not at all a bad bargain in effecting an exchange with the manufacturers of the cable, who held the debentures, of the 4 per cent. debentures of this company for the 6 per cent. debentures of the Direct Spanish Company. The lines of the Mediterranean Extension Company had also been purchased, adding another link to an important system. The company had established a very sound footing in Egypt, and an equally sound footing in the Red Sea. Their relations with the Egyptian and English Governments were such that as long as they could do the work as well as they had done it in the past, they could hope to retain the traffic between the two countries. The amount of work done during the last three years was almost startling. The average of paying words transmitted had been 10,300,000 per annum; the number of non-paying words—addresses, &c.—being 3,700,000, or altogether, nearly 14 million words had been transmitted every year during the last three years, making a daily average, including Sundays, of £38,300 words. He alluded to this extraordinary traffic for two reasons: firstly, to show how much they were in the hands of the young men employed in sending those messages; and secondly, to direct their attention to the difficulties to be contended with in maintaining such a system. He desired to ask the sympathies of the shareholders, of the Press, and of the general public, and their consideration for the trying circumstances they were often under. Referring to the suit instituted against the company by the Central News, he said after many days' sifting of the case they were placed in a very proud position indeed. The wonder was, looking at the frequent attempts to tamper with their employés, that the whole thing came out as pure and satisfactory as it did. He had sympathy with those correspondents of the Press who thought they were first with important information but found they were second; but if they looked at the amount of Press correspondence, and the pressure in every way brought to bear on the company's system, they must come to the conclusion that only one could be first, and it was very hard that the company should be called upon to incur such enormous expense in defending an action of that kind. They had endeavoured to keep ther system as correct as it was possible to do. They had confidence in most of their young men, but if any gentleman, whether a Press correspondent or a merchant, attempted to tamper with and demoralise their staff by giving them money in order to obtain priority for his messages, the matter rested with him, and not with the directors, and such were not the men who should attack them in the way they had been attacked. Their general manager (Sir James Anderson) had been pilloried as few men had been, but after the seven days' investigation and the decision of the Lord Chief Justice, he had no need to be ashamed to hold up his head. (Hear, hear.) He was sorry to hear that that business was not at an end yet; he was sorry for the gentleman who was taking all the trouble, and he thought if he would only give them credit, as they gave him credit, for desiring to do the best they could, it would suit his purpose better than by continuing the litigation. He then moved, "That the printed report and accounts of the directors to 31st March, 1884, submitted to this meeting be and they are hereby received and adopted; that a dividend on the preference shares of the company to the 30th June, 1884, at the rate of 6 per cent. per annum be paid, less income tax; and that, in accordance with the directors' recommendation, a dividend be and is now declared of 2s. 6d. per share, with a bonus of 1s. per share, both free of income tax, on the ordinary shares of the company, making, with previous payments by way of dividends on account, a total payment of 6 per cent. on those shares for the year ended 31st March, 1884."

The Marquis of Tweeddale seconded the resolution.

A Shareholder, who admitted that he was not present during the whole of the chairman's speech and had not read the report, put several questions upon subjects which had already been dealt with, and suggested that, as the service messages of the company had brought them into such trouble, these should be discontinued altogether for the future.

Mr. Hurst said he had never heard a statement more satisfactory than that made by the chairman of the manner in which the immense business they had to deal with had been conducted; the only wonder was that mistakes were not often made and that such a business could be carried on with so much regularity. Recollecting the experience of the past, he thought the dividend of 6 per cent. very satisfactory.

The Chairman, in reply to the shareholder mentioned, said if they were to abolish service messages they would have to shut up their stations altogether, as it was only by means of such messages that they were enabled to conduct their business.

The resolution was put and carried unanimously; a vote of thanks, on the motion of Mr. Griffiths, being afterwards accorded to the chairman and directors, the meeting then terminating.

Faure Electric Accumulator Company, Limited.

AN extraordinary general meeting of this company was held on Monday at the City Terminus Hotel, to consider the confirmation of the resolution passed at the meeting on the 19th ult. for the voluntary winding up of the company.

Mr. Harcourt Turner presided, and said he wished distinctly to disabuse the minds of the shareholders of an impression which seemed to prevail among some of them that the company would cease to exist if it went into voluntary liquidation. The only difference in the position would be that its affairs would be carried on by liquidators instead of directors.

Mr. A. R. Brown stated that important facts had come to his knowledge within the last few days, which led him to hope and

believe that the company might recover its property. He suggested that the opinion of the Solicitor-General should be taken as to the contract of 1882 with the Electrical Power Storage Company, by which their rights and privileges in the United Kingdom had been ceded to that company. He thought the meeting should be adjourned for a fortnight, and that the resolution meantime should not be confirmed. If his suggestion were adopted, he would be willing at once to hand the directors a cheque for 200 guineas, or more, if necessary, to obtain the high legal opinion he had mentioned.

Mr. Henry Staples said that if the sale of their patents to the Storage Company was *ultra vires*, it might be cancelled by process of law.

Sir A. J. Otway, M.P., said he had had nothing to do with the company (of which he was formerly chairman) since 1882, but he had always taken a great interest in it. He was of the same opinion as Mr. Staples as to the value of the patents, but according to information he had received, their property had been very improperly parted with. He did not believe that anything could touch the contract of July, 1882, as it was made under legal advice, and valuable consideration was given for it. At that time also the Faure patents were very much threatened by those who held the Sellon-Volckmar inventions. The secretary would say whether he was right, that that contract was submitted to a general meeting.

Mr. Herbert Canning (the secretary) replied that it was "foreshadowed," not submitted, to a general meeting. At the request of the chairman, Mr. Canning afterwards read a letter which had been received that morning from Paris, from M. Philippart, who wrote protesting against the proposal to go into liquidation, urging the shareholders to vindicate their right to the exclusive possession of the Faure patents for the whole of the United Kingdom, and contending that the Sellon-Volckmar patents were nothing but a counterfeit of the Faure patents.

The Chairman then stated that it might be injurious to the interests of the company to adjourn the meeting, as the letters which had been received by the committee left no doubt on his mind that if there were any delay others would try and obtain the winding-up of the company.

Mr. Brown stated that in that case he would not propose an adjournment.

The resolution was then confirmed on the motion of the chairman, and Messrs. F. Cooper (of Messrs. Cooper Brothers, chartered accountants), H. Canning, and A. R. Brown were afterwards appointed liquidators, with power for any two of them to act.

Maxim-Weston Electric Company, Limited.—The Order of the High Court of Justice, Chancery Division, dated 14th June, 1884, confirming the reduction of the capital of this company from £500,000 to £250,000, and the minute (approved by the Court) showing, with respect to the capital of the company as altered, the several particulars required by the statutes, were registered by the Registrar of Joint Stock Companies' on the 2nd inst. The minute is as follows:—"The capital of the Maxim-Weston Electric Company, Limited, is £250,000 divided into 500,000 shares of 9s. each. At the time of the registration of this minute 200,000 of the shares have been issued, of which 198,000 are deemed to be fully paid up, and 2,000 of such shares are deemed to have 9s. per share paid up thereon, and the remaining 300,000 have never been issued."

Telephone Company of Ireland, Limited.—Subscriptions are invited for Five per Cent. Preference Shares, payable 5s. per share on application, 5s. on allotment, and the balance as may be required at intervals of not less than three months, with power to the company to redeem the same at a premium of 10 per cent.

Mediterranean Extension Telegraph Company, Limited.—The liquidators have received intimation from Rome that the bill authorising the transfer of their undertaking to the Eastern Telegraph Company, Limited, has now received the assent of both Houses of Parliament, and awaits only the sanction of the King. (Later information is to the effect that the entire arrangements have been completed.)

Stock Exchange.—Application has been made to the Committee of the Stock Exchange to grant a quotation to additional preference and ordinary shares of the Globe Telegraph and Trust Company, Limited.

St. George Telephone Company, Limited.—Creditors are requested to communicate in the usual manner with Mr. George Boggis, of 14 and 15, St. Swithin's Lane, London, the official liquidator, on or before the 19th of August next.

The West Coast of America Telegraph Company, Limited.—A dividend has been declared of 4s. per share on the £10 shares of this company, or at the rate of 4 per cent. per annum for the half-year ending June 30th last.

TRAFFIC RECEIPTS.

The Great Northern Telegraph Company. The receipts for June, 1884, £22,900; from 1st January to 30th June, 1884, £129,520; corresponding months, 1883, £123,488; 1882, £116,527.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending 4th July, were £2,534, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

5088. "Arrangement of circuits and apparatus for the distribution of electricity." J. S. BEEMAN. Dated October 26. 6d. The inventor takes two or more batteries or sets of batteries, so arranged or constructed as to produce currents of equal or nearly equal electromotive force, and equal or nearly equal current producing capacity by their being fitted, when necessary, with means whereby the production of current and electromotive force are regulated, either or both, according to requirements. These batteries may consist of thermo piles, primary or secondary batteries, dynamo or magneto-electric machines, or a combination of any of the above, or any other convenient and suitable form of generator or producer of electric energy. And the positive conductor from the first battery is taken by a convenient route towards the second battery, and alongside and parallel to negative conductor of the second battery, and the positive conductor of the second battery is taken by a convenient route towards the third battery, and alongside and parallel to the negative conductor of the third battery, and the positive conductor from the third battery is carried in the same manner to the next, and this arrangement is continued until the positive conductor of the last battery proceeds towards the first battery, and alongside and parallel to negative conductor of the first battery.

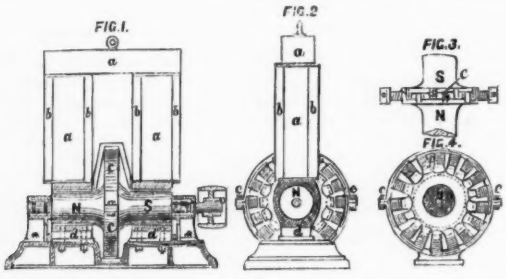
5202. "Electric meters." R. BELFIELD. Dated November 1. 6d. For the purpose of measuring electric potential, and especially the potential of rapidly alternating currents, the inventor employs an instrument in some respects similar to a Thomson electrometer. It has four double quadrants, mounted upon an insulating base, and connected together in pairs, the opposite quadrants forming a pair. In proximity to these, and between the upper and lower surfaces of the double quadrants, a needle is suspended by a wire. The form of the needle is approximately that of one pair of quadrants. The needle can be set to a zero point by a capstan head at the upper end of the suspending wire, and in connection with the head there is a pointer which indicates upon a scale the distance through which the head is moved, and consequently the torsion required to bring the needle to the zero. When the instrument is applied to the measurement of the potential of a generator yielding alternating currents, such as commonly employed in electric lighting, one terminal of the machine is connected with one pair of quadrants, and the other terminal with the other pair; also one terminal is connected with the needle through the suspending wire. Under these conditions the needle and one pair of quadrants are similarly electrified, and the needle is repelled by these quadrants, but attracted by the other pair. This causes the needle to leave the zero point. The needle is brought back by turning the capstan head, and the amount of this movement is read upon the scale, which may be so graduated as to admit of the potential being read off directly in volts.

5238. "Electric generators." H. J. HADDAN. (Communicated from abroad by the Bain Electric Company, of Chicago.) Dated November 5. 10d. The invention consists, first, in the construction of the various mechanical parts of a generator, and the combinations of the same; and, second, in the methods and means of arranging the circuits and commutators in electric generators.

5400. "Telephone apparatus." M. KOTYRA. Dated November 15. 2d. A permanent, or it may be an electro-magnet, of flat or other convenient section, as may be found most convenient and suitable, is, according to one modification, bent in the form of a portion of a circle, advantageously of a C shape, the poles of which are brought in close proximity to each other, and their ends free to vibrate, negative to positive. The magnet is fixed, rigidly, at an equidistant point, and thus allows the ends to freely vibrate. A small electro-magnet is connected by suitable means on to the respective poles, at or near each end of the C shaped permanent or electro-magnet before described. One pole of one of the before mentioned electro-magnets is fixed by means of a small screw, or other suitable fastening to a disc, or plate, of metal (not necessarily iron), and as may be found most convenient in practice. The other pole is provided with an adjustable device, whereby the distances apart of the poles of the electro-magnets can be adjusted to the greatest nicety. The apparatus before described is fixed in a case or handle of any suitable construction or material. (*Void by reason of the patentee having neglected to file a Specification in pursuance of the conditions of the Letters Patent.*)

5422. "Dynamo-electric machines and electro-motors." Sir C. T. BRIGHT. Dated November 17. 6d. Consists of improvements in dynamo-electric machines and electro-motors which have for their object the simplification and increased efficiency of the apparatus and the reduction of the cost of maintenance and repairs. Fig. 1 shows a front elevation, partly in section, of a machine constructed according to the invention, in which *a*, *a*, *a*, represent the iron parts of an electro-magnet, *b*, *b*, *b*, *b*, being the space occupied by the wire. The poles of the electro-magnet are shown in section surrounding the induced shaft or pole-pieces, N, S, in close proximity to, but not in contact with, the poles. An outer ring, *c*, *c*, carries the fixed armature coils hereafter described; *d*, *d*, are castings of non-magnetic metal supporting and separating the poles from the bed-plate. Fig. 2 represents a side elevation of a similar machine to which the same lettering applies. Fig. 3 shows the construction of the induced pole-pieces, N, S, of the previous figures, which are divided in the centre by a disc of

non-magnetic metal, *e*; at *n*, *s*, are shown two of the teeth which form the extremities of N and S. In fig. 4, *c*, *c*, is the outer ring of non-magnetic metal shown under the same letters as in figs. 1 and 2; *f*, is one of the series of coils composing the fixed armature ring. The electro-magnets, *a*, *a*, in the figures 1 and 2, may



be excited by a separate continuous current machine, or by a voltaic battery or other electrical generator. The stationary armature coils are connected to fixed terminals, so that no rubbing or rolling surfaces or collectors, such as are usually employed in alternating machines, are requisite.

5448. "Telephonic or microphonic apparatus." H. H. LAKE. (Communicated from abroad by J. Berliner, of Hanover.) Dated November 19. 6d. This invention relates to telephonic or microphonic apparatus, and comprises the employment of a powder which is a conductor of electricity, and which is used under pressure as described. In carrying the said invention into practice, the inventor provides a speaking tube, which is wound around a drum, and one end of which is placed in a metallic bush. A brass disc, in which this bush is fitted, is connected by means of screws with another disc of insulating material, and between the said discs is inserted a perforated plate covered with a thin sheet or blade of platinum. This platinum blade serves as a rest or support for the powder, which consists of small conducting particles, such, for instance, as graphite or iron filings. Upon this powder rests a disc or weight, the underside of which is also covered with a sheet or blade of platinum, whilst its periphery is surrounded with cotton wool. This disc or weight carries a small rod, which is connected by means of a conducting band or strip (of gold, for example) with an attachment screw. This attachment screw rests upon a plate of insulating material, and is connected at its underside with a conducting wire which leads to one of the wires of an induction coil. A wire fastened to another attachment screw leads to the battery. The current passes to the first-named attachment screw through the above mentioned conducting band or strip and the rod and through the conducting powder, the perforated plate, and the brass disc, and leaves through the wire connected with the last-named attachment screw. When a person speaks into the speaking tube the sound waves are propagated through the apertures of the perforated plate to the thin sheet or blade of platinum lying thereon, and exert a greater or less pressure upon the loose conducting particles of the powder, thereby causing an increase or decrease in the intensity of the current.

5465. "Meter for electric currents." A. M. CLARK. (Communicated from abroad by L. Hours-Humbert, of France.) Dated November 20. 6d. The apparatus consists essentially of a contact arm rotated by clock work at any suitable speed (preferably at the rate of 10 revolutions per hour or one in six minutes), said arm closing at each revolution the circuits of as many sub-derivations as there are lamps or apparatus to be measured. The circuits thus closed are sub-derivations of the primary derivations or branches, wherein are placed the lamps or other apparatus which are in multiple arc as usual. Thus each time that the arm closes the circuit through a sub-derivation a portion of the current passes through said sub-derivation provided that the current is then traversing the lamp or apparatus placed in the primary derivation to which said sub-derivation corresponds, each passage of the current through a sub-derivation advances to the extent of one tooth, one of the wheels of the registering train, which it will be readily understood, will thus aggregate the several periods of time during which the several lamps or apparatus are in work.

5469. "Secondary batteries." F. M. LYTE. Dated November 20. 4d. This invention relates in part to improvements in the secondary battery or accumulator described in the provisional specification filed by the inventor on the 13th July last (No. 3452.) According to the former invention the active material used in the battery consisted of a number of studs, prisms, or short bars of spongy lead, having flanges, collars, or other projections, these being set in supports composed of metallic sulphides with or without an excess of sulphur. The inventor has since found that these supports may with advantage be made of lead or pewter, antimonial lead or type or Britannia metals, placing them back to back (as described in my above mentioned specification) with or without a central plate of some conducting material placed between them, against which the flat ends of the studs or prisms rest, and are pressed closely into contact. The inventor also proposes to construct a battery with a central plate composed of lead, antimonial lead, pewter, Britannia, or type metals, foil, gauze, net or tissue of sufficiently stout silver or platinum.

5472. "Electric lamps." H. H. LAKE. (Communicated from abroad by T. J. McTighe and J. T. McConnell, of America.) Dated November 20. 6d. Relates to electric arc lamps, and consists partly in providing a normal open path of low resistance around the electrodes and placing therein two points of closure, one of which shall be made by the abnormal movement of the armature of either the usual regulating helix or the derivation helix of high resistance; and the other of which shall be made by the lower electrode and broken by the pressure of the upper electrode thereon; in consequence of which the by-path established will be mechanically ruptured by the contact of the electrodes, so that practically there is, at any moment, only a single path open to the main current.

5503. "Telegraphic and telephonic apparatus." H. H. LAKE. (Communicated from abroad by F. Van Rysselberghe, of Belgium.) Dated November 23. 8d. Comprises the combination and arrangement of telephonic and telegraphic apparatus whereby ordinary telegrams sent by the Morse, Hughes, Wheatstone or other apparatus, and telephonic conversations may be simultaneously transmitted by the same wire or wires over long distances. It is essential that the telegraphic branches should not be connected with the earth, except by high resistances. It is also essential that the telegraphic currents should rise to their maximum strength and diminish gradually, and that ordinary sudden currents, such as those resulting from the closing and opening of circuits without precaution, should not be employed. And in order to obtain these gradual currents the inventor employs electro-magnets of a resistance of about 500 ohms, intercalated in the line at the points of departure and return or interposed between the battery and the manipulator; or he employs condensers placed in derived or branch circuits from the line at the departure and at the return; or he employs a combination of electro-magnets and condensers, the arrangement which is preferred being that shown in fig. 1, in which M is the manipulator, P the battery, R the telegraphic receiver, the electro-magnet of which must not have a resistance much less than 500 ohms. A^1 and A^2 are electro-magnets of about 500 ohms resistance, C is a condenser of about 2 microfarads, and *t* is the earth. The inventor also obtains gradual currents by the employment of a manipulator provided with a rheostat operating in such a manner that at the closing of the circuit it interposes a gradually decreasing resistance, and at the opening of the said circuit it interposes a gradually increasing resistance. The inventor has ascertained, and this forms an important feature of the present invention, that the gradual currents obtained by either of the above described means are inaudible and not perceptible in the telephone either directly or by induction, that is to say, neither the primary currents, nor the derived or induced currents which proceed therefrom are heard in the telephonic receiver, and by reason of this fact telephonic conversations can be carried on not only by means of wires attached to the said posts, carrying the telegraph wires, when the latter are only traversed by gradual currents, but by means of the said telegraph wires. In fact, assuming that, in order to avoid telephonic induction, the wires of one line are

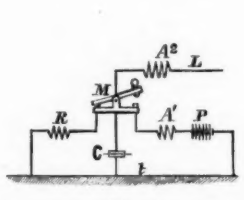


FIG. 1.

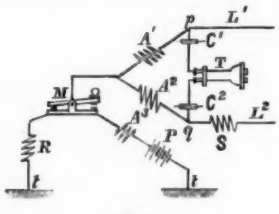


FIG. 2.

coupled two and two, each couple forming relatively to the other wires of the same line a symmetrical system as perfect as possible. Then, in order to utilise for the transmission of spoken messages, a couple consisting of two telegraph wires; or in order to utilise for telegraphy a couple consisting of two ordinary telephonic wires transmitting spoken messages, the inventor has recourse to the following arrangement:—Let L^1 and L^2 (fig. 2) be the two wires of a couple; A^1, A^2, A^3, three electro-magnets of about 500 ohms resistance, the two first occupying the two sides of a Wheatstone bridge, and the third being interposed between the battery P and the manipulator M; R the receiver of a telegraphic installation M R P; C^1, C^2, two condensers of about half a microfarad intercalated with an ordinary telephonic installation, T, upon the diagonal, *p*, *q*, of the Wheatstone bridge; and S a suitable resistance placed either upon one of the two lines or upon one of the sides of the bridge, or upon each of the two lines; it will always be possible, by properly regulating the resistance, S, to cause the points, *p* and *q*, to be maintained at the same potential for all currents emitted at M, or for all currents of equal intensity caused to pass in the same direction upon the two lines, L^1 and L^2. The telephone will then not be influenced either by the telegraphic currents or by the induced currents acting simultaneously upon the two lines, L^1 and L^2. But the telephonic conversation will be carried on by the double wire as if the telephonic installation alone existed. It is not indispensable that A^1, A^2 and A^3, should be electro-magnets, they may be simple resistances each of about 500 ohms. L^2 may be an artificial line reduced to a simple resistance, S, connected on the one hand with the point, *q*, and on the other hand with the earth, *t*. A telephonic communication and a telegraphic communication are thus obtained by means of a single wire, L^1. Other arrangements are also described.

CORRESPONDENCE.

Automatic Reversing Commutators.

I notice in your issue of June 21st a letter from Messrs. Ayrton and Perry respecting the Automatic Reversing Commutator described by you in your issue of April 5th. I have no intention to enter into any controversy whatever, but I cannot allow such a misstatement to pass unnoticed.

In the first place it is stated that working drawings with this apparatus attached were sent me—this is untrue; there was no centrifugal governor at all, but an arrangement of friction blocks to move the commutator in either direction required, and I have the drawings to prove it; as to the commutator, it was merely illustrated to show how the parts acted, it being, in fact, nothing but the commutator used in the cheap induction coils, the arms acting between the pins instead of pressing on the top of the same.

With regard to the *special* mode of fixing the commutator pieces (*i.e.*, an arm about five inches long, fastened *at one end* by two short screws *an inch apart* just screwed into a wooden block), all I can say is, that such a commutator would not be efficient a few days, as there was no provision whatever to keep the pieces apart but the aforesaid screws.

The governors in Specification No. 4532 are entirely different from those I constructed, the slight modification, kindly admitted by Messrs. A. and P., being the kernel of the whole nut, viz., the reversal of direction of rotation to reverse the angle of the commutator brush frame, and I challenge Messrs. A. and P. to prove that they had such an arrangement even on paper before I sent the drawing to them, at the same time giving it to them if of any value. They kindly allow me to alter the machine which caused considerable delay, and at last refused to accept its delivery because the Faure Company had transferred its interest to another Company. Messrs. A. and P. now admit in their letter what I all along suspected, that the machine was for *them*.

As to the machine driving my tramcar, a very short trial on a small car proved its unsuitableness for that purpose.

Magnus Volk.

Brighton.

Primary Batteries.

I think the remarks contained in the note, in your last issue, on Primary Batteries, are unfair to that of Lalande and Chaperon and calculated to mislead those who have no special knowledge of the subject.

You say "A necessary qualification for the economical production of the electric light by means of primary batteries is a high E.M.F., and the Lalande element has about the lowest with which we are acquainted." Now the first part of this statement is hardly correct, as since the invention of the "glow lamp" and the introduction of the multiple arc system of connecting up, the efficiency of a primary battery for lighting purposes depends on a high E.M.F. *in relation to its internal resistance.*

This condition the Lalande element appears to fulfil, for though ·97 volt would be a low E.M.F. for a cell with an internal resistance of—say, ·75 ohm, it is high compared with an internal R. of ·075 ohm.

Of course the Lalande battery is not well suited to run one lamp alone, but that is not the point, as one lamp is seldom or never required by itself. Thus, though eight cells are required to run one lamp of 7 ohms and 1 amp., 15 would run seven such lamps connected parallel; for the resistance of the lamps would be reduced to 1 ohm, and the current required would be 7 amps., *e.g.*—

$$C = \frac{14{\cdot}5}{R\,(1) + r\,(1{\cdot}025)} = 7{\cdot}2$$

Certainly, as regards economy, the use of a low E.M.F. entails thicker leads; but in a small private installation this would not be a matter of much consequence.

G. H. Bays, Jun.

Wakefield, *7th July*, 1884.

[We usually endeavour to write in such a way as to lead, not to mislead, the uninitiated in electrical matters, and we fail to see that our correspondent has advanced anything to negative our remarks of last week.—EDS. ELEC. REV.]

Canadian Telegraph Lines.

An article under the above heading appeared in your issue of 14th June, and as it originated from parties interested in the maintenance of telegraph lines by an incorporated association versus the assumption thereof by the Government, as in England, I beg leave to state—

That the special objects for which the Canadian Government telegraph service was established were—

1. The safety and convenience of Atlantic coast and Gulf of St. Lawrence navigation.
2. To aid in the development of the fisheries upon the plan so successfully inaugurated by the Government of Norway and Sweden, and
3. To assist settlers in British Columbia and the North-West provinces.

Meteorological and signal service information being transmitted free of charge, any direct revenue was of little or no consideration when Parliament cheerfully voted the necessary sums for the establishment of so humanitarian and useful an institution, for it is scarcely necessary to add that no company would undertake a service which was not directly profitable to their shareholders.

The expenditure upon such work has been nearly $800,000; the annual cost of maintenance is about $55,000, and the rapidly-increasing revenue about $27,000. On capital account about $375,000 has been expended in the cables and land lines which connect the Islands of Anticosti, the Magdalen and Bird Rock Islands, Grand Manan and other Islands in the Bay of Fundy, and the roadless coast line of the north shore of the St. Lawrence; and $425,000 was for the pioneer lines erected during the survey of the Canadian Pacific Railway and properly chargeable to that enterprise.

In British Columbia alone the revenue has increased from $5,300 during 1879-80, to $25,000 during 1882-83, and will balance expenditure during the next fiscal year.

You will thus note that the quotation referred to is misleading, and has no bearing upon the advantages derivable from the wise assumption, in the interest of the public, by the British Government of the entire telegraph service of the country.

F. N. Gisborne.

Ottawa, Canada,
25th June, 1884.

Continuous Current Inductional Transformers.

After a careful examination of Mr. E. L. Voice's description of a continuous current induction apparatus, published in your last issue, I fail to perceive in it any real resemblance to my inductional transformers, for, while in my apparatus the current is induced by the continuous movement of the poles, that of Mr. E. L. Voice acts by means of alternations of polarity, thus inducing an alternating current, which is converted into a uni-direction current by a reversing commutator.

In fact, Mr. E. L. Voice does not "utilise the same principles as those upon which the Siemens-Altneck and Pacinotti-Gramme dynamos are constructed," as this utilisation of the principles of action of the machines which "generate continuous currents without employing a reversing commutator," forms an

essential point of novelty in my inductional transformers, it will be plain that Mr. E. L. Voice's apparatus is totally different in its action to those described by me, and that the only similarity exists in the use of concentric rings wound with wire coils.

May I ask how it is that Mr. E. L. Voice takes no notice of the latest form of my apparatus, which consists of three concentric rings, one of them having no commutator and being capable of rotation? Is it because it is impossible even for Mr. E. L. Voice to stretch his elastic patent sufficiently to make it appear to cover that arrangement also?

I would also point out that the use of a pair of rotating commutators with brushes inserted respectively in the primary and secondary circuits of an induction bobbin, in order to obtain uni-direction currents from the secondary coils is no novelty, as it has been described and used many years ago, yet this old device constitutes the main feature in Mr. E. L. Voice's continuous current induction apparatus.

With reference to the remark with which Mr. E. L. Voice concludes his letter, I must say that I came to an analogous conclusion some time back on reading a communication by him in which he completely ignores the all important laws of the conservation of energy.

F. de Wolffers.

July 6th, 1884.

Overhead Wires.

In a recent issue of your journal you described a system of carrying cables along streets designed by Mr. Cracknell, of New South Wales, and about to be applied between the General Post Office and Redfern railway station, Sydney. As I am well acquainted with the locality, perhaps you will allow me to explain that such a structure as Mr. Cracknell proposes has a peculiar adaptability to that city and our Australian colonies generally, it being usual there to protect the sidewalks from the sun's rays by awnings of no temporary nature, indeed in many cases corrugated iron replaces canvas and proves a protection from both rain and sunshine. Vertical posts from the kerb of the sidewalk are therefore frequent, and to replace them by light and elegant ironwork adds to the beauty of the street, and is of great utility to the shopkeepers.

This cannot, however, be regarded as the true solution of the overhead wire question, as the expense in British cities, where its utility for the purpose of supporting our temporary awnings is questionable, would not be qualified by its serving this double purpose.

In conversation with professional men anent this subject, one is struck with the almost unanimous opinion that the danger so much harped upon by outsiders is almost purely imaginary; still, as engineers, we are more or less servants of the public, and if the people demand protection from even an imaginary danger the matter must receive the engineers' attention. Indeed, sufficient agitation seems already to exist against the present position of the wires to cause inventors to patent a variety of "underground" designs to meet what they consider will be the demand of the future.

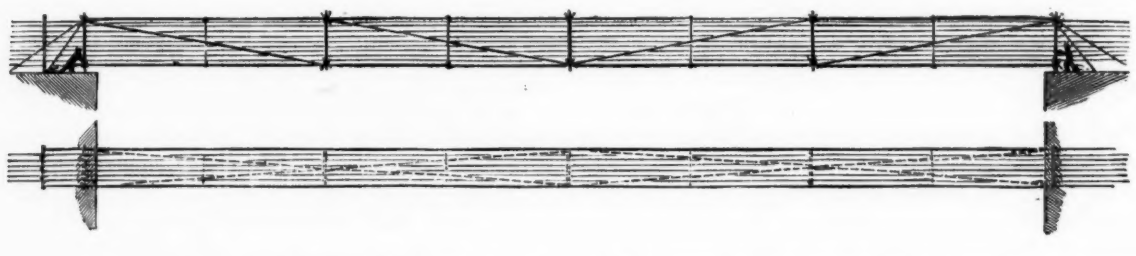
Now considering the immense disadvantages that accompany underground conductors, that alternative is the last that should be adopted, and in this case it seems to me that the consulting engineer can, with ordinary common sense, coupled with a knowledge of the strength of the materials, at once quiet the nerves of the public.

To make the matter clearer I have illustrated a light structure, of my own design, that surrounds the wires and effectually prevents any of them, *when* they do break, from falling into the street below. Some persons would, perhaps, at once exclaim: "You have only added to the danger!" But to such alarmists one can only say that if so, then we must also remove our railway bridges, and, in fact, every other structure that may be unsupported throughout its entire length. It need not therefore be urged with the readers of this class of journal that the safety of such a structure can be assured.

Referring to the illustration, which is designed for a very long span, it will be seen that light tubular frames are employed, supported by diagonal braces, and the bays may, if desired, be filled in with wire netting; but, provided light wire guards are fixed around the main wires, at frequent intervals, between the tubular frames, the short length of broken telegraph wire that would hang down would not reach low enough into the street to do damage.

For replacing the old wires, or erecting new, grooved pulleys are fixed to the supporting standards on the housetops, and an endless wire rope runs around them, so that by simply lashing one end of a length of telegraph wire to this rope, and revolving the pulley, this end is passed through the frames to the other side of the street without interference with the traffic beneath.

It would prove advantageous for all wires to cross the streets at right angles, and, therefore, be of short spans, and to be concentrated within these protective cages at such suitable positions as they may be placed. This would leave more open space over the streets, and, were these structures provided with gilded rosettes and finials covering the connections, I venture to predict that a light and elegant structure would be the result, satisfying the most æsthetic as regards appearance, and reassuring the most timid as regards safety.



In conclusion I must ask Mr. Cracknell, when this meets his eye, to pardon the criticism of a fellow member of the Engineering Association of the Colony; and I hope that you, gentlemen, will excuse such a lengthy inroad on your space.

C. Scott Snell.

London, *July 4th*.

The History of the Telephone.

I take the liberty of writing to ask whether any of your readers can kindly inform me of the date of the paper by M. Charles Bourseul, on the possibility of transmitting speech by electricity, referred to by Count du Moncel on folio 4 of his work entitled "The Telephone, the Microphone and the Phonograph."

If this paper was reproduced by the Count in his book published in 1854, it strikes me that it must be anterior to the article in the *Didaskalia* referred to by Mr. Berliner in your journal of 28th June. In fact, I think, after comparing the two articles, that the last mentioned appears to have been written after its author's perusal of the former.

A. Danvers.

Lisbon, *4th July*, 1884.